



STATEMENT OF WORK
FOR
FOCUSED REMEDIAL INVESTIGATION/FEASIBILITY STUDY
RICHARDSON FLAT TAILINGS SITE
SUMMIT COUNTY, UTAH
UT980952840

INTRODUCTION

United Park City Mines Company ("United Park") submits this Statement of Work ("SOW") to perform a focused remedial investigation/feasibility study at the Richardson Flat Tailings Site, located in Summit County, Utah (the "Site"). In support of this SOW, United Park has prepared a Focused Remedial Investigation/Feasibility Study Work Plan (the "Focused RI/FS Work Plan"), which is attached hereto as Exhibit A and incorporated by reference to this SOW. At the request of United States Environmental Protection Agency ("EPA") Region 8, this SOW has been prepared based on and in conformance with EPA's July 2, 1991 Model Statement of Work for PRP-Conducted Remedial Investigations and Feasibility Studies (EPA's "Model SOW"). This work is being conducted in full cooperation with both the EPA and the Utah Department of Environmental Quality (UDEQ).

As described in Section 1.0 of the Focused RI/FS Work Plan, United Park is the current owner of a large parcel of property (the "Property"), comprising approximately 700 acres, located in Summit County, Utah. Figure 1.0 of the Focused RI/FS Work Plan shows the general geographic location of the Property. A historic mine tailings impoundment, consisting of a large, geometrically closed basin formed by an earth embankment and a series of perimeter containment dikes, covers approximately 160 acres of the Property and is sometimes referred to as "Richardson Flat" or simply the "Site." The tailings impoundment resulted from decades of mining and milling silver-laden ore in the area around Park City known as the Park City Mining District. The Site is depicted in Figure 2.0 of the Focused RI/FS Work Plan.

The Site has remained unused since mining and milling operations ceased in 1982. Over the past fifteen years, EPA Region 8, the Utah Department of Environmental Quality ("UDEQ") and United Park have been investigating the Site in order to characterize the Site and determine potential adverse impacts to human health and the environment associated with the Site. At the same time, United Park has been implementing a series of remedial measures at the Site intended to mitigate any potential adverse impacts on human health and the environment.

The objectives of this focused remedial investigation/feasibility study ("RI/FS") are to further investigate the nature and extent of contamination at the Site, to supplement the investigation efforts performed at the Site to date, to collect sufficient data to support EPA's risk assessment and analysis, to confirm that the measures implemented at the Site to date are adequate to support final closure of the Site and, if necessary, develop and evaluate potential additional remedial alternatives to support final Site closure. EPA will evaluate whether current Site conditions are protective of human health and the environment, and if necessary, whether further remedial measures will provide additional protection. The focused RI and FS are interactive and may be conducted concurrently so that the additional data collected in the focused RI influences the development of additional remedial alternatives in the FS, which in turn affects the data needs and the scope of treatability studies, if any are required.

United Park will conduct this focused RI/FS (except for the focused risk assessment component and any community involvement activities which will be conducted by the EPA) and will produce a draft RI/FS report that are in accordance with this SOW, and to the extent appropriate for the Site, the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (U.S. EPA, Office of Emergency and Remedial Response, October 1988), and any other guidance that EPA uses in conducting a RI/FS (a list of the primary guidance is attached), as well as any additional requirements in the administrative order. United Park will furnish all necessary personnel, materials, and services needed, or incidental to, performing the focused RI/FS, except as otherwise specified in the administrative order.

At the completion of the focused RI/FS, EPA and UDEQ will be responsible for the selection of a site remedy and will document this selection in a Record of Decision (ROD). The remedial action alternative selected by EPA and UDEQ will meet the cleanup standards specified in CERCLA Section 121. That is, the selected remedial action will be protective of human health and the environment, will be in compliance with, or include a waiver of, applicable or relevant and appropriate requirements of other laws, will be cost-effective, will utilize permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable, and will address the statutory preference for treatment as a principal element, as appropriate for the Site. The final focused RI/FS report, as adopted by EPA and UDEQ and EPA's focused risk assessment will, with the administrative record, form the basis for the selection of the Site's final closure remedy and will provide the information necessary to support the development of the ROD.

As specified in CERCLA Section 104(a)(1), as amended by SARA, EPA will provide oversight of United Park's activities throughout the focused RI/FS. United Park will support EPA's initiation and conduct of activities related to the implementation of oversight activities.

TASK 1 - SCOPING

As described in Section 3 of the Focused RI/FS Work Plan, since the 1970s, numerous environmental investigations have been conducted relating to the Site. The reports and data from these prior investigations are very useful in determining the scope of additional investigative activities needed to bring final closure to the Site. From 1985 to 1988 and from 1992 to 1993, the EPA conducted and reported on investigations at the Site. Based on previous and current environmental studies and existing Site conditions, United Park has developed a conceptual model of the Site. As described in Section 4 of the Focused RI/FS Work Plan, the Preliminary Site Model will be used to scope and evaluate the need for supplemental remedial investigation work (as described in Section 5 of the Focused RI/FS Work Plan) to assist in the development of further remedial measures to support final Site closure. United Park will develop a Preliminary Site Model in coordination with EPA and UDEQ.

As described in the Focused RI/FS Work Plan, the Site is similar in construction and characteristics to other tailings impoundments found throughout Utah and other Rocky Mountain States. The tailings on this Site are non-reactive and were derived from ore bodies contained in carbonate host rocks. Soil, surface water, and groundwater media will be addressed in both the additional investigative work and in the evaluation of further remedial measures as part of the RI/FS work to be performed pursuant to this SOW. Recent and past investigations show that the tailings are underlain by native high-clay-content soils, sitting within an enclosure constituting a large, geometrically closed impoundment, covered with a vegetated soil cover. There is a surface water diversion ditch system that surrounds the impounded tailings. Because the characteristics of the Site are similar to other tailings impoundments in the Rocky Mountain region, much is known about such sites generally and about the effectiveness of such an impoundment's construction. Such information will also be very useful in determining the scope of additional investigative activities needed to bring final closure to the Site.

When scoping the specific aspects of a project, United Park will meet with EPA and UDEQ to discuss all project planning decisions and special

concerns associated with the Site. As a function of the project planning process, United Park will perform the activities described below.

a. Site Background and Site Visit

According to EPA's Model SOW, the respondent will gather and analyze the existing site background information and will conduct a site visit to assist in planning the scope of the RI/FS. The respondent will also collect and analyze existing data and document the need for additional data. Before planning RI/FS activities, all existing site data will be thoroughly compiled and reviewed by the respondent. Specifically, this will include presently available data relating to the varieties and quantities of hazardous substances at the site, and past disposal practices. This will also include results from any previous sampling events that may have been conducted. This information will be utilized in determining additional data needed to characterize the site, better define potential applicable or relevant and appropriate requirements (ARARs), and develop a range of preliminarily identified remedial alternatives.

According to EPA's Model SOW, the respondent will also conduct a site visit during the project scoping phase to assist in developing a conceptual understanding of sources and areas of contamination, as well as potential exposure pathways and receptors at the site. This information will be utilized to better scope the project and to determine the extent of additional data necessary to characterize the site, better define potential ARARs, and narrow the range of preliminarily identified remedial alternatives.

Consistent with EPA's Model SOW, United Park has gathered and analyzed the existing Site background information and has conducted numerous Site visits to assist in scoping its focused RI/FS. The results of these efforts are reported in Sections 2, 3 and 4 of the Focused RI/FS Work Plan. This information was utilized in determining additional data needed to characterize the Site, and will assist to better define potential ARARs and develop a range of preliminarily identified additional remedial alternatives. The results of these efforts are reported in Sections 5 and 7 of the Focused RI/FS Work Plan. In addition, United Park has conducted site visits with personnel from the EPA and UDEQ. The Site work completed from 1985 to 1993 by EPA and UDEQ has provided a great deal of background information on the Site. There is a good deal of institutional knowledge about the Site.

b. Project Planning

According to EPA's Model SOW, once the respondent has collected and analyzed existing data and conducted a site visit, the specific project scope will be planned. Project planning activities include those tasks described below, as well as identifying data needs, developing a work plan, designing a data collection program, and identifying health and safety protocols.

As described in the Focused RI/FS Work Plan, United Park has been implementing a series of remedial measures at the Site intended to mitigate any potential adverse impacts on human health and the environment.

As the result of previous Site operations and United Park's remedial efforts, United Park believes that key elements are already in place to support final Site closure. These closure elements include:

- Installation of multiple monitoring wells to monitor groundwater conditions in and around the Site
- Construction of a large, earth embankment and a series of containment dikes to contain the tailings
- Construction of a diversion ditch system surrounding the impoundment to collect and redirect surface and ground water
- Placement of a vegetated clay soil cover to isolate the tailings, to prevent tailings from becoming wind-borne, and to minimize the infiltration of water to the tailings
- Installation of a security fence to limit Site access

Based on the data collected from and the remedial measures that have already been implemented at the Site to date, and in consideration of remedial measures implemented at similar tailings impoundment sites throughout Utah and other Rocky Mountain States, United Park believes that final Site closure can be achieved without the implementation of further remedial measures.

However, United Park recognizes that EPA has concerns about Site conditions that the agency believes must be addressed through additional Site characterization and possibly through the implementation of additional remedial measures. Therefore, United Park agrees to further investigate the nature and extent of contamination at the Site to supplement the investigation efforts performed at the Site to date and confirm that the measures implemented at the Site to date are adequate to support final closure of the

Site. If necessary, based on the findings of these efforts, United Park will also develop and evaluate potential additional remedial alternatives to support a final closure of the Site that is protective of human health and the environment, and consistent with contemplated future land use of the Site. United Park proposes to use the data derived from the Focused RI/FS (together with a focused risk assessment to be performed by EPA) to determine whether any further remedial measures are needed to support final Site closure. If and to the extent further remedial measures are required, United Park believes that any appropriate final remedy for the Site should be consistent with and incorporate, to the maximum extent practicable, all elements of the existing Site closure.

According to EPA's Model SOW, if remedial actions involving treatment have been identified by the respondent or EPA, treatability studies will be required except where the respondent can demonstrate to EPA's satisfaction that they are not needed. Where treatability studies are needed, initial treatability testing activities (such as research and study design) will be planned to occur concurrently with site characterization activities.

As previously described in this SOW and in the Focused RI/FS Work Plan, United Park will develop and evaluate potential additional remedial alternatives to support a final closure of the Site that is protective of human health and the environment, and consistent with contemplated future land use of the Site. As described in Section 7.0 of the Focused RI/FS Work Plan, a preliminary list of such additional remedial measures may include:

- Improving and maintaining the main embankment stability and integrity
- Improving and maintaining the soil cover
- Improving and maintaining the surface drainage
- Improving and maintaining the diversion ditches
- Excavating tailings located outside of the impoundment, placing the same within the impoundment, and placement of additional cover
- Establishing appropriate institutional controls to prevent unacceptable exposure risks

At this time, such preliminary additional remedial measures would not involve treatment of hazardous wastes or substances. Consequently, it is unlikely that treatability studies would need to be performed as part of the evaluation and selection of final additional remedial measures to support final closure of the Site. However, if new information comes to light as a result of

United Park's focused RI/FS efforts, or if circumstances change, then United Park will evaluate the need for and conduct, as necessary, treatability tests in accordance with the NCP and as approved by EPA.

According to EPA's Model SOW, the respondent will conduct a preliminary identification of potential state and federal ARARs (chemical-specific, location-specific and action-specific) to assist in the refinement of remedial action objectives, and the initial identification of further remedial alternatives and ARARs associated with particular actions. ARARs identification will continue as site conditions, contaminants, and remedial action alternatives are better defined.

As described in Section 7.0 of the Focused RI/FS Work Plan, evaluation of any further remedial alternatives to support the final Site closure will include an assessment of the feasibility and overall effectiveness of such measures based on the requirements of CERCLA and the NCP. This will include a focused risk assessment (to be performed by EPA) that is based on possible future land use scenarios. At the outset of the focused feasibility study, ARARs for the final Site closure will be preliminarily identified. Since the range of possible future land uses will be set out early in the process, the proposed ARARs will be focused on a narrow range of remedial measures to support final Site closure. ARARs identification will continue as Site conditions, contaminants, and remedial action alternatives are better defined.

- c. Scoping Deliverables -- Focused RI/FS Work Plan, Sampling and Analysis Plan, and Health and Safety Plan.

The Focused RI/FS Work Plan is attached to this SOW and will be deemed approved upon EPA's signature of the AOC. The Sampling and Analysis Plan, and Health and Safety Plan will be submitted to the agencies within 60 days of EPA's signing of the AOC.

According to EPA's Model SOW, at the conclusion of the project planning phase, the respondent will submit a RI/FS work plan, a sampling and analysis plan ("SAP"), and a site health and safety plan ("HASP"). The SAP provides a mechanism for planning field activities and consists of a field sampling plan (FSP) and a quality assurance project plan (QAPP). The FSP will define the sampling and data-gathering methods that will be used on the project. The QAPP will describe the project objectives and organization, functional activities, and quality assurance and quality control (QA/QC) protocols that will be used to achieve the desired data quality objectives ("DQOs"). The HASP will be prepared in conformance with the respondent's

health and safety program, and in compliance with OSHA regulations and protocols. The RI/FS work plan and SAP must be reviewed and approved by EPA prior to the initiation of field activities.

As previously indicated in this SOW, United Park has prepared a Focused RI/FS Work Plan, attached hereto as Exhibit A. United Park will also prepare a SAP (which includes a FSP and QAPP) and HASP prior to conducting any supplemental field work at the Site. Consistent with EPA's Model SOW, the Focused RI/FS Work Plan and SAP will be reviewed and approved by EPA prior to the initiation of field activities.

TASK 2 - COMMUNITY RELATIONS

The development and implementation of community relations activities are the responsibility of EPA and UDEQ. Although implementation of the community relations plan is the responsibility of EPA and UDEQ, United Park may assist by providing information regarding the Site's history, participating in public meetings, or by assisting in the preparation of fact sheets for distribution to the general public. United Park may establish a community information repository, at or near the Site, to house one copy of the administrative record. The extent of United Park's involvement in community relations activities is left to the discretion of the agencies. United Park's community relations responsibilities, if any, will be specified in the community relations plan. All community relations activities conducted by United Park will be subject to oversight by EPA.

TASK 3 - SITE CHARACTERIZATION

a. Field Investigation

During this phase, the Focused RI/FS Work Plan, SAP, and HASP are implemented. As set forth in Section 5 of the Focused RI/FS Work Plan, the supplemental field investigation will include the gathering of additional data to further define site physical and biological characteristics, sources of contamination, and the nature and extent of contamination at the Site. These activities will be performed by United Park in accordance with the Focused RI/FS Work Plan and SAP. United Park will initiate field support activities following approval of the Focused RI/FS Work Plan and SAP. Field support activities may include obtaining access to the site, scheduling, and procuring equipment, office space, laboratory services, and/or contractors, as appropriate. United Park will notify EPA at least two weeks prior to initiating field support activities so that EPA may adequately schedule oversight tasks.

United Park will also notify EPA in writing upon completion of field support activities.

b. Data Analysis

In accordance with the Focused RI/FS Work Plan, United Park will analyze and evaluate the existing and any newly-collected data to describe: (1) site physical and biological characteristics, (2) contaminant source characteristics, (3) nature and extent of contamination and (4) contaminant fate and transport. The RI data will be presented in a format (i.e., computer disc or equivalent) to facilitate EPA's preparation of the focused risk assessment. United Park shall agree to discuss and then collect any data gaps identified by the EPA that need to be filled in order to complete the focused risk assessment. (See "Guidance for Data Usability in Risk Assessment - OSWER Directive # 9285.7- 05 - October 1990.) Additionally, the data will be used in combination with the focused risk assessment to facilitate the implementation of any additional remedial measures that are deemed necessary for the Site through the Feasibility Study that follows.

c. Data Management Procedures

Information gathered during the supplemental Site characterization work will be consistently documented and adequately recorded by United Park in well-maintained field logs and laboratory reports. Field logs will be utilized to document observations, measurements, and significant events that have occurred during field activities. Laboratory reports will document sample custody, analytical responsibility, analytical results, nonconformity events, corrective measures and/or data deficiencies, and adherence to prescribed protocols.

d. Remedial Investigation Report Deliverable

After completing the supplemental field sampling and analysis, a draft RI Report will be prepared and submitted by United Park to EPA and UDEQ for review and approval. The draft RI report will contain a Site characterization summary that will provide EPA with a preliminary reference for developing the focused risk assessment. The Site characterization summary will also be used by United Park to assist in confirming that the measures implemented at the Site to date are adequate to support final closure of the Site, and in evaluating the development and screening of further remedial alternatives and the refinement and identification of ARARs. The draft RI report shall summarize and evaluate results of past and recent field activities

to characterize the Site, sources of contamination and the fate and transport of contaminants. United Park will refer to the RI/FS Guidance for an outline of the report format and contents. Following comments by EPA and UDEQ, United Park will prepare a final RI report, which satisfactorily addresses EPA and UDEQ comments.

TASK 4 - TREATABILITY STUDIES

As described earlier in this SOW and in Section 7.0 of the Work Plan, United Park will develop, evaluate and recommend, as necessary, potential additional remedial alternatives to support a final closure of the Site that will be protective of human health and the environment, and consistent with the contemplated future land use of the Site. At this time, such additional remedial measures would not involve treatment of hazardous wastes or substances. Consequently, it is unlikely that treatability studies would need to be performed as part of the evaluation and selection of final additional remedial measures to support final closure of the Site. However, if new information comes to light as a result of United Park's focused RI/FS efforts, or if circumstances change, then United Park will evaluate the need for and conduct, as necessary, treatability tests in accordance with the NCP and EPA's Model SOW and as approved by EPA.

TASK 5 - DEVELOPMENT AND ANALYSIS OF FURTHER REMEDIAL ALTERNATIVES

As described in Section 7.0 of the Focused RI/FS Work Plan and previously in Task 1.b of this SOW, United Park believes that final Site closure can be achieved without the implementation of further remedial measures. However, United Park recognizes that EPA has concerns about Site conditions that the agency believes must be addressed through additional Site characterization and possibly through the implementation of additional remedial measures. Therefore, United Park agrees to further investigate the nature and extent of contamination at the Site to supplement the investigation efforts performed at the Site to date and confirm that the measures implemented at the Site to date are adequate to support final closure. United Park notes that it is currently considering long-term, non-residential land uses at the Site and the Property. While the Property outside the impoundment is already suitable for development, the Property is not currently being used for any productive purpose. United Park is considering developing the area outside of the actual impoundment for non-residential, recreational uses. United Park is also considering non-residential uses, consistent with the soil cover and any appropriate institutional controls, for the southern area of the tailings impoundment area itself.

Based on the findings of these additional investigation and evaluation efforts, United Park proposes to use the data derived from the Focused RI/FS (together with a focused risk assessment to be performed by EPA) to facilitate the determination of whether any further remedial measures are needed to support final Site closure. If necessary, as part of the focused feasibility study, United Park will develop appropriate remedial action objectives, and develop and evaluate potential additional remedial alternatives, to support a final closure of the Site that is protective of human health and the environment, taking into consideration the low-toxicity volume of the on-Site tailings materials, as well as remedial measures implemented at similar tailings impoundment sites throughout Utah and the Rocky Mountain States. If and to the extent further remedial measures are required, United Park believes that any appropriate final remedy for the Site should be consistent with and incorporate, to the maximum extent practicable, all elements of the existing Site closure, and with contemplated future land use of the Site.

United Park will develop and evaluate a range of appropriate further remedial alternatives to support final Site closure, concurrent with the RI Site characterization task. Based on EPA's focused risk assessment, United Park will review, and if necessary and appropriate for the Site: 1) modify the site-specific remedial action objectives; 2) develop general response actions for each medium of interest to satisfy the remedial action objectives; 3) identify areas or volumes of media to which general response actions may apply, taking into account requirements for protectiveness as identified in the remedial action objectives; 4) identify, screen and document technologies, if any, applicable to each general response action to eliminate those that cannot be implemented at the site; and 5) assemble and document further alternative remedial measures. Such remedial measures may include, for example, removal, treatment and containment of the on-Site tailings materials, as well as a "no-action" alternative.

United Park will conduct a detailed analysis of additional remedial alternatives to support final closure of the Site, which will consist of an analysis against a set of nine evaluation criteria to ensure that the selected additional remedial measures will be protective of human health and the environment; will be in compliance with, or include a waiver of, ARARS; will be cost-effective; will utilize permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable; and will address the statutory preference for treatment as a principal element (if appropriate). The evaluation criteria include: (1) overall protection of human health and the environment; (2) compliance with ARARS;

(3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state (or support agency) acceptance; and (9) community acceptance. (Note: criteria 8 and 9 are considered after the focused RI/FS report has been released to the general public.)

United Park will submit a draft FS report to EPA for review and approval. Once United Park has addressed EPA's comments, the final FS report may be bound with the final RI report. This report, as ultimately adopted or amended by EPA, provides a basis for remedy selection by EPA and documents the development and analysis of further remedial alternatives to support final closure of the Site. United Park will refer to the RI/FS Guidance for an outline of the report format and the required report content, as appropriate for the Site.

REFERENCES FOR CITATION

The following list, although not comprehensive, comprises many of the regulations and guidance documents that apply to the RI/FS process:

The (revised) National Contingency Plan

"Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, " U.S. EPA, Office of Emergency and Remedial Response, October 1988, OSWER Directive No. 9355.3-01

"Interim Guidance on Potentially Responsible Party Participation in Remedial Investigation and Feasibility Studies," U.S. EPA, Office of Waste Programs Enforcement, Appendix A to OSWER Directive No. 9355.3-01.

"Guidance on Oversight of Potentially Responsible Party Remedial Investigations and Feasibility Studies," U.S. EPA, Office of Waste Programs Enforcement, OSWER Directive No. 9835.3

"A Compendium of Superfund Field Operations Methods," Two Volumes, U.S. EPA,. Office of Emergency and Remedial Response, EPA/540/P-87/001a, August 1987, OSWER Directive No. 9355.0-14.

"EPA NEIC Policies and Procedures Manual," May 1978, revised November 1984, EPA-330/9-78-001-R.

"Data Quality Objectives for Remedial Response Activities, " U.S. EPA, ffice of Emergency and Remedial Response and Office of Waste Programs Enforcement, EPA/540/G-87/003, March 1987, OSWER Directive No. 9335.0-7B.

"Guidelines and Specifications for Preparing Quality Assurance Project Plans," U.S. EPA, Office of Research and Development, Cincinnati, OH, QAMS-004/80, December 29, 1980.

"Interim Guidelines and Specifications for Quality Assurance Project Plans," U.S. EPA, Office of Emergency and Remedial Response, QAMS-005/80, December 1980.

"Users Guide to the EPA Contract Laboratory," U.S. EPA, Sample Management Office, August 1982.

Interim Guidance with Applicable or Relevant and Appropriate Requirements,' U.S. EPA, OFFICE of Emergency and Remedial Response, July 9, 1987, OSWER Directive No. 9234.0-05.

"CERCLA Compliance with Other Laws Manual," Two Volumes, U.S. EPA, Office of Emergency and Remedial Response, August 1988 (draft), OSWER Directive No. 9234.1-01 and -02.

"Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites," U.S. EPA, Office of Emergency and Remedial Response, (draft), OSWER Directive No. 9283.1-2.

"Draft Guidance on Superfund Decision Documents," U.S. EPA, Office of Emergency and Remedial Response, March 1988, OSWER Directive No. 9355.-02

"Risk Assessment Guidance for Superfund - Volume I Human Health Evaluation Manual (Part A), EPA/540/1-89/002

"Risk Assessment Guidance for Superfund - Volume II Environmental Evaluation Manual," March 1989, EPA/540/1-89/ 001

"Guidance for Data Usability in Risk Assessment," October, 1990, EPA/540/G-90/008

"Performance of Risk Assessments in Remedial Investigation/Feasibility Studies (RI/FSS) Conducted by Potentially Responsible Parties (PRPs)," August 28, 1990, OSWER Directive No.9835.15.

"Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," April 22, 1991, OSWER Directive No. 9355.0-30.

"Health and Safety Requirements of Employed in Field Activities," U.S. EPA, Office of Emergency and Remedial Response, July 12, 1981, EPA Order No. 1440.2.

OSHA Regulations in 29 CFR 1910.120 (Federal Register 45654, December 19, 1986).

"Interim Guidance on Administrative Records for Selection of CERCLA Response Actions," U.S. EPA, Office of Waste Programs Enforcement, March 1,1989, OSWER Directive No. 9833.3A.

"Community Relations in Superfund: A Handbook," U.S. EPA, Office of Emergency and Remedial Response, June 1988, OSWER Directive No. 9230.0#3B.

"Community Relations During Enforcement Activities And Development of the Administrative Record," U.S. EPA, Office of Programs Enforcement, November 1988, OSWER Directive No. 9836.0-1a.

**FOCUSED REMEDIAL
INVESTIGATION/FEASIBILITY STUDY
WORK PLAN**

**RICHARDSON FLAT TAILINGS SITE
SUMMIT COUNTY, UTAH**

UT980952840

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May 25, 2000

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION AND BACKGROUND	3
2.1 Site Operational History.....	4
2.2 Description of Existing Closure Measures and Elements.....	6
2.2.1 Main Embankment and Containment Dikes.....	6
2.2.2 Natural Underlying Clay Soils.....	7
2.2.3 Vegetated Soil Cover	7
2.2.4 Diversion Ditches.....	8
2.2.5 Fencing.....	9
2.3 Regional Geology	9
2.4 Regional Hydrogeology	10
2.5 Surface Water.....	12
3.0 PREVIOUS SITE INVESTIGATIONS	14
3.1 Air Monitoring Investigations	15
3.2 Tailings Cover Investigations	16
3.3 Studies of Tailings Impoundment Integrity and Stability.	17
3.4 Groundwater Investigations	18
3.5 Investigations of Surface Water Quality.....	22
4.0 PRELIMINARY SITE MODEL.....	24
4.1 The Tailings Impoundment.....	25
4.2 Other Tailings Materials.....	26
4.3 Surface Water.....	26
4.4 Groundwater	30
4.5 Identification of Potential Contaminant Migration Pathways.....	31
5.0 SUPPLEMENTAL REMEDIAL INVESTIGATION WORK.....	32
5.1 Tailings Cover Investigation.....	33
5.2 Off-Impoundment Tailings Investigation	34
5.3 Wind-Blown Tailings	36
5.4 Surface Water.....	37

5.5	Groundwater	39
5.6	Main Embankment Investigation.....	41
5.7	Sampling and Analysis and Health and Safety Plans	42
6.0	FOCUSED RISK ASSESSMENT.....	43
7.0	TREATABILITY STUDIES	43
8.0	FURTHER REMEDIAL ACTION.....	43
9.0	DELIVERABLES	46
10.0	SCHEDULE.....	47
11.0	COMMUNITY RELATIONS	47

1.0 INTRODUCTION

Respondents (as defined in the Administrative Order on Consent (U.S. E.P.A. Docket No. _____), dated _____, 2000) (the AOC”) submit this Focused Remedial Investigation/Feasibility Study ("RI/FS") Work Plan pursuant to the Statement of Work, Focused Remedial Investigation/Feasibility Study, Richardson Flat Tailings Site, Summit County, Utah, UT980952840.” United Park City Mines Company (“United Park”) is the current owner of a large parcel of property (the "Property"), comprising approximately 700 acres, located in Summit County, Utah. Figure 1.0 shows the general geographic location of the Property. A historic mine tailings impoundment, consisting of a large, geometrically closed basin formed by an earth embankment and a series of perimeter containment dikes, covers approximately 160 acres of the Property and is sometimes referred to as "Richardson Flat" or simply the "Site." The tailings impoundment resulted from decades of mining and milling silver-laden ore in the area around Park City known as the Park City Mining District. The Site is depicted in Figure 2.0.

The Site has remained unused since mining and milling operations ceased in 1982. Over the past fifteen years, the United States Environmental Protection Agency ("EPA"), the Utah Department of Environmental Quality ("UDEQ"), and United Park have been investigating the Site in order to characterize the Site and determine potential adverse impacts to human health and the environment associated with the Site. At the same time, United Park has been implementing a series of remedial measures at the Site intended to mitigate any potential adverse impacts on human health and the environment.

As the result of previous Site operations and United Park's remedial efforts, Respondents believe that key elements are in place to support final Site closure. These existing closure elements include (i) the installation of multiple monitoring wells to monitor groundwater conditions in and around the Site; (ii) the construction of a large, earth embankment and a series of containment dikes to contain the tailings; (iii)

construction of a diversion ditch system surrounding the impoundment to collect and redirect; (iv) the placement of a vegetated clay soil cover to isolate the tailings, to prevent tailings from becoming wind-borne, and to minimize the infiltration of water to the tailings; and (v) the installation of a security fence to limit Site access.

Based on available data from the Site and from similar tailings impoundments, Respondents believe that the tailings impoundment as currently closed does not unacceptably impact upon, and does not otherwise pose unacceptable risks to, human health or to the environment. Respondents further believe that final Site closure can be achieved without the implementation of further remedial measures. On the other hand, Respondents recognize that EPA and UDEQ have expressed concerns about Site conditions that the agencies believe must be addressed through additional Site characterization and possibly through the implementation of additional remedial measures.

Therefore, Respondents propose to use the data collected to date concerning the Site (after an evaluation of its suitability for use in the RI/FS process) and the data derived from the proposed, Focused Remedial Investigation and Feasibility Study, to facilitate an evaluation of the effectiveness and appropriateness of the existing in-place remedies and to determine whether any further remedial measures are needed to support final Site closure.

If and to the extent further remedial measures are required at all, Respondents believe that any appropriate final remedy for the Site should incorporate to the maximum extent practicable all existing elements of Site closure.

The purpose of this Work Plan is to outline additional Site characterization work to be performed that will gather data to assist in the evaluation of the soundness and appropriateness of the existing remedies and, to the extent necessary, recommend additional remedial measures to support final Site closure. This and other data will also be presented for use by the EPA to perform a focused risk assessment. It will also be used in the Focused Remedial Investigation and Feasibility Study final reports both consistent with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 ("CERCLA") and the National Contingency Plan ("NCP") to support final site closure.

This Work Plan describes current knowledge about the Site and its history, summarizes investigation and characterization work completed to date, presents a conceptual model of the Site, and describes the additional investigative, risk assessment, feasibility study, and community relations work to be performed. This Work Plan also presents a description of the anticipated reports and deliverables and a project schedule.

2.0 SITE DESCRIPTION AND BACKGROUND

The Richardson Flat Property covers approximately 700 acres in a small valley in Summit County, Utah, located one and one-half miles northeast of Park City, Utah. The tailings impoundment Site covers approximately 160 acres in the northwest corner of the Property and lies within the NW quarter of Section 1 and NE quarter of Section 2, Township 2 South, Range 4 East, Summit County, Utah. Figure 2.0 shows the Site boundary.

In 1988, during the first proposal by the EPA to place the Site on the NPL, the site boundaries were limited to the impoundment area and adjacent lands. It did not include the area known as the floodplain tailings. The floodplain area, along with the Park City Municipal Landfill were evaluated as part of the work completed by the EPA in 1992 in connection with EPA's second proposal to list the Site on the NPL.

For the purposes of this Focused RI/FS, the Site will include the area shown on Figure 2. The Park City Municipal Landfill is physically separated from and has no operational connection with the Site, and thus, is not a part of the Site for purposes of this focused RI/FS.

Likewise, the Focused RI/FS does not propose including the floodplain tailings as part of the Site. As noted more fully in United Park's comments to EPA's proposals to list the site on the NPL, there is no evidence linking the floodplain tailings to the Site. The flood plain tailings are located in an area that is upgradient from the Site and on the other side of the railroad bed, a physical barrier that isolates the floodplain tailings from the Site. But more important, analytical data from the floodplain tailings indicate

that they are of a different nature and composition than the tailings deposited at the Site. All of the evidence leads to the conclusion that the floodplain tailings are composed of upstream tailings mixed with the natural fluvial sediments in Silver Creek. The floodplain tailings originated upstream from the tailings located on the Silver Maple unpatented mining claims (BLM ownership) and the Silver Creek Tailings site (Prospector Square, Park City) and were carried downstream in Silver Creek to the floodplain. Therefore, the floodplain tailings area is also not a part of the Site for purposes of this focused RI/FS.

2.1 Site Operational History

United Park was formed in 1953, with the consolidation of Silver King Coalition Mines Company and Park Utah Consolidated Mines Company, both publicly traded mining companies at the time. Tailings were first placed at the Site prior to 1950. The mill tailings present at the Site consist mostly of sand-sized particles of carbonate rock with some minerals containing silver, lead, zinc and other metals. While few specific details are known about the exact configuration and operation of the historic tailings pond, certain elements of prior operations are apparent. It appears that from time to time, tailings were transported to the Site through three distinct low areas on the Property. Over the course of time, tailings materials also settled out into these three low areas that were ultimately left outside and south of the present impoundment area as constructed in 1973-74. An embankment constructed along the western area of the Site also appears to have been in place as part of the original design and construction of the tailings pond, but few details are known of the original embankment.

In 1970, Park City Ventures ("PCV"), a joint venture partnership between Anaconda Copper Company ("Anaconda") and American Smelting and Refining Company ("ASARCO"), entered into a lease agreement with United Park to use the Property for disposal of additional mill tailings resulting from renewed mining in the area. PCV contracted with Dames & Moore to provide construction specifications for reconstruction of the Site for continued use as a tailings impoundment (Dames & Moore, 1974). The

State of Utah approved PCV's proposed Site operations based on Dames & Moore's design, construction, and operation specifications. Before disposing of tailings at the Site, PCV installed a large, earth embankment along the western edge of the existing tailings impoundment and constructed perimeter containment dike structures along the southern and eastern borders of the impoundment to allow storage of additional tailings. *See Figure 2.0.* PCV also installed a diversion ditch system along the higher slopes north of the impoundment and outside of the containment dike along the east and south perimeter of the impoundment to prevent surface runoff from the surrounding land from entering the impoundment. PCV also installed groundwater monitoring wells near the base of the main embankment, as part of the required approval process by the State of Utah.

PCV conveyed tailings to the impoundment by a slurry pipeline from its mill facility located south of the Site. Over the course of its operations, PCV disposed of approximately 420,000 tons of tailings at the Site. In addition to developing construction specifications for the Site, Dames & Moore also provided PCV with operating requirements for the tailings pond and slurry line, that were also approved by the State of Utah as a requirement for operating the Site. Dames & Moore recommended, among other things, that PCV operate the slurry line in such a way so as to deposit tailings around the perimeter of the tailings impoundment and moving towards the center of the impoundment (Dames & Moore, 1974 at 21). This is also common operating practice in the industry. Unfortunately, PCV failed to follow the Dames & Moore requirement and operated the slurry line in such a way that a large volume of tailings were placed near the center of the impoundment in a large, high-profile, cone-shaped feature. After cessation of operations by Noranda in 1982, the presence of this cone-shaped feature of the tailings pond resulted in the prevailing winds cutting into the tailings and the tailings materials becoming wind-borne. Had the slurry line been operated according to the Dames & Moore specifications, the high-profile tailings cone would not have existed and prevailing winds would not have been a significant potential exposure pathway at the Site.

Between 1980 and 1982, Noranda Mining, Inc. ("Noranda") leased the mining and milling operations and placed an additional, estimated 70,000 tons of tailings at the Site. No new tailings have been placed at the Site since Noranda ceased its operations.

2.2 Description of Existing Closure Measures and Elements

Over the years, certain efforts have been taken at the Site that can be used to support final closure. More specifically, tailings at the Site are presently contained through a combination of man-made and natural factors, discussed below.

2.2.1 Main Embankment and Containment Dikes. As explained above, the majority of the tailings at the Site are contained in a geometrically closed basin, with a large, earth, embankment (the "main embankment") in place along the western edge of the Site. The main embankment is vegetated and is approximately 40 feet wide at the top, 800 feet long, and has a maximum height of 25 feet (Dames & Moore 1980, at Plate 2). The main embankment was designed to permit seepage of water from the impoundment to relieve hydraulic pressure on the embankment. In March of 1974, Dames & Moore recommended to PCV, and in November 1980, recommended to Noranda, that engineered seepage controls be installed at the base of the main embankment. (Dames & Moore 1974, 1980 at 9 and 16, respectively) It appears that neither company followed this recommendation. A series of man-made containment dikes contain the tailings along the southern and eastern perimeter of the impoundment. The northern edge of the impoundment is naturally higher than the perimeter dikes.

In 1980, Dames & Moore investigated the tailings impoundment structures for Noranda and noted that the main embankment was not constructed in accordance with its original design specifications and noted that it was oversteepened in some areas. Nevertheless, Dames & Moore did not have any immediate concerns about the stability of the main embankment at that time. While Dames & Moore did express reservations if additional tailings were added to the impoundment over a long period of time, Noranda ceased mining and milling operations in 1982 and no tailings or slurry water have been

disposed of at the Site since that time. Respondents agree with previous investigations that portions of the main embankment are oversteepened and were not constructed in accordance with original design recommendations. As part of the Focused RI/FS, Respondents will design an appropriate wedge buttress to address this problem. This work is further described in Section 5.6.

2.2.2 Natural Underlying Clay Soils. Past geotechnical studies by Dames and Moore and the more recent Weston report indicate that the impoundment is underlain by native high clay-content soils with sufficiently low permeability to support closure in place for the tailings. Existing data demonstrates that there is no hydraulic connection between the tailings impoundment and underlying groundwater systems, as discussed in more detail in sections 2.4, 3.4, 4.4, and 5.5 below.

2.2.3 Vegetated Soil Cover. During active operations at the Site by PCV and Noranda, tailings were slurried to the Site, using some 60 gallons of water per minute under normal operations. When Noranda ceased operations in 1982, the tailings pond was, for the most part, full of water and was too soft and unstable to get onto the impounded tailings with heavy equipment. Starting in 1983, United Park began placing soil cover on tailings outside of the impoundment, located in the three low areas south of the south diversion ditch (*See Figure 2.0*). By 1985, the tailings impoundment had dried out enough in certain areas to support heavy equipment and United Park began installing soil cover material over those portions of the tailings impoundment using soil from both the Park City area and from within the Property. The soil cover consists of clay-rich soil, with kaolinite being the predominant clay mineral (Weston, 1999 at 4).

The soil cover was installed at that time in large part to prevent prevailing winds from cutting into the cone-shaped tailings feature left at the Site by previous operators. United Park focused its initial efforts on placing soil cover around the cone-shaped tailings feature to eliminate the possibility of wind-blown tailings from leaving the impoundment. Several feet of cover were required in areas around the cone-shaped feature in order to provide for a reasonable final grade of the impoundment. By 1988,

work around and on the cone-shaped tailings feature had been completed and other areas of the tailings had begun to dry out enough to support additional work. United Park then began a more aggressive program to cover all exposed tailings. Drought conditions during the early 1990s created sufficiently stable conditions to allow United Park to complete the soil cover, even on areas that had contained, at times, ponded water. At least 12 inches of low-permeability, clay cover material is in place in the north-west area of the impoundment where ponded water occurred. Currently, there are no areas of exposed tailings material on the Site. The soil cover is also vegetated largely due to United Park's efforts to re-seed the area with appropriate plant species.

The purposes of the soil cover are to prevent direct contact with the tailings material, to prevent tailings from becoming wind-borne, and to minimize the infiltration of surface water into the tailings materials. Although United Park believes the existing soil cover is sufficient to protect human health and the environment, United Park intends to confirm the lateral and vertical extent of the existing soil cover and will evaluate the need for further remedial measures on the soil cover. This is further described in more detail in section 5.1, below.

2.2.4 Diversion Ditches. A diversion ditch system borders the north, south, and east sides of the impoundment to prevent runoff from the surrounding land from entering the impoundment (See Figure 2.0). Precipitation falling on the impoundment area creates the limited volume of seasonal surface water that can be seen on the Site. The north diversion ditch collects snowmelt and storm water runoff from upslope, undisturbed areas north of the impoundment and carries it in an easterly direction towards the upstream origin of the south diversion ditch. An unnamed ephemeral drainage to the southeast of the impoundment also enters the south diversion ditch at this point. Additional water enters the south diversion ditch from other areas lying south of the impoundment at a point near the southeast corner of the diversion ditch structure (See Figure 3.3). This water consists of spring snowmelt and storm water runoff. Water in the south diversion ditch flows from east to west and ultimately empties into Silver Creek just

upstream of Highway 189 near the north border of the Property. Although a discrete flow of water from the south diversion ditch to Silver Creek is maintained only during the higher water periods of the year.

In 1992 and 1993, United Park reconstructed the south diversion ditch by decreasing the slope of its banks from nearly vertical to a more gradual slope. United Park also placed a clay soil cover over the re-sloped banks of the south diversion ditch, down to and including areas of the banks underwater. The new banks were then seeded with appropriate varieties; presently, the existing ditch banks are vegetated. United Park did not disturb the bottom of the ditch bed. Since doing this work, surface water quality data has shown marked improvement from year to year and the downward trend in metals content measured in the surface water continues to this day (*See Figure 3.2a*). In May of 1999, United Park reconstructed the north diversion ditch along its entire length. United Park intends to continue to collect surface water quality and sediment characterization data from the south diversion ditch system, as described in more detail in section 5.4, below.

2.2.5 Fencing. In the mid 1980s, United Park installed a fence along most of the Property boundary, including the entire impoundment and much of the property south of the impoundment in order to restrict and control access to the Site. United Park maintains the fence in good repair and United Park intends to continue to do so to control access to the Site until such time as limited access is no longer necessary, consistent with Property redevelopment.

2.3 Regional Geology

The Property lies within the Park City East Geologic quadrangle map as recorded by the U.S. Geologic Survey (*See Figure 2.1*). Geologic maps at a scale of 1:24,000 compiled by Crittenden and others (1966) and by Bromfield and Crittenden (1971) cover this and nearby quadrangles. Bryant (1990) provides a regional 1:100,000-scale map of the area.

The Property is located within a complex fold and thrust belt that was later intruded and overlain by volcanic rocks. Sedimentary bedrock near the Property, dated in the Paleozoic to Mesozoic period in age, is overlain by a thick layer of extruded volcanic rock, dips approximately 25 to 60 degrees to the north, and strikes generally northeast-southwest (Crittenden and others, 1966; Bromfield and Crittenden, 1971). The Tertiary gravels and volcanic rocks unconformably overlie Mesozoic sedimentary rocks. No known faults exist near the Site.

Tailings on the Site lie on top of alluvial/colluvial sediments that are 30 to 50 feet in depth and are the product of the erosion of the adjacent and underlying volcanic extrusives. Review of borehole data indicates that these sediments are comprised of:

- Two to five feet of soft, organic and clay-rich topsoil
- One to 30 feet of various mixtures of fine-grained silt and clay
- Four feet of sand and gravel
- Variable thickness of highly-weathered, volcanic breccia composed of relatively soft, tight, sandy and silty clay, grading to moderately hard, slightly to moderately fractured volcanic rock.

2.4 Regional Hydrogeology

Hydrogeology in the area is characterized by shallow alluvial aquifers located in fine-grained, alluvial and colluvial material, and the deeper, Silver Creek Breccia bedrock aquifer located in the Keetley volcanics. Bromfield and Crittenden (1971) describe this unit of the Keetley volcanics as consisting of intermediate laharic breccias with less common flow breccias and interlayered tuffs. In the subsurface, the weakly consolidated Silver Creek Breccia is interlayered with sedimentary rocks. These sedimentary layers are more numerous toward the base of this unit and consist of quartzite, limestone, siltstone, and shale.

The shallow aquifers are generally encountered from fifteen to thirty feet below the ground surface, in confined and unconfined conditions, and located in gravelly

clay. Fine-grained, silty clays cover the top aquifer, and clay and silt separate the shallow aquifers from each other. The shallow aquifer structure appears to be consistent from south of the Site to Silver Creek on its northwest border.

Recent exploratory drilling (designed to better assess groundwater resources for private entities) about 1.5 miles northwest of the Property indicates that the paragenetic relationship between the Tertiary volcanic rocks and associated sediments are complex. Wells located approximately three miles northwest of the Property in Sections 16 and 22, Township 1 South, Range 4 East, Salt Lake Base and Meridian (SLB&M) either flowed to the surface following completion or had shallow static water. These wells indicate that confined to semi-confined aquifers comprise both shallow and deeper aquifer(s) within the Tertiary volcanic rocks and deeper associated sediments. Pump testing and monitoring of water levels in local wells that tap both the shallow and deeper aquifers indicate no apparent hydraulic communication between the shallow and deeper Tertiary volcanic rocks and associated sediments (Pers. Comm. Todd Jarvis, September 1999).

The hydraulic conductivity, effective transmissivity, saturated thickness, and effective porosity for the Tertiary volcanic rocks and associated sediments were derived from nearby wells. Controlled aquifer test data are available for wells located in Sections 16 and 22, Township 1 South, Range 4 East, SLB&M. Analysis of data collected from the well indicates that near-well transmissivities approach 110 to 310 ft²/day with lateral variations in aquifer permeability that both increase and decrease the aquifer's transmissivity (Weston, 1999). For example, Park City Municipal Corporation (PCMC) recently installed a test well in the southeast corner of Section 34, Township 1 South, Range 4 East, approximately one mile northwest of Property. The well was spudded on the weathered Keetley Volcanics with the underlying Thaynes Limestone as the targeted aquifer. However, the Thaynes Limestone was not encountered at the final drilled depth of 1,000 feet. While the exploratory boring developed water from the fractures in the unweathered Keetley volcanic rocks, the quantity of water that reasonably could be developed from the Keetley Volcanics at this location was between 100 to 200 gpm with

long-term drawdown estimated at 250 to 300 feet (specific capacity = 0.33 to 0.4 gpm per foot of drawdown or a transmissivity of 30 to 50 ft² /day). This yield was considerably less than the quantity desired by PCMC for a municipal water supply, and the well remains unused (Hansen, Allen & Luce, 1996, letter report to PCMC).

Generally speaking, the hydraulic gradients in the shallow aquifers roughly parallel topography (i.e., from South to North) except near the southern boundary of the tailings embankment, where the diversion ditch causes the flow to change to the northwest (Weston, 1999 at 6). This northerly bearing orientation of the hydraulic gradient is consistent with regional trends mapped by Brooks and others (1998). Based on the artesian flow observed during the course of drilling the previously described wells located north of the Property, the unconsolidated sediments in this area have a low vertical permeability and local semi-confined to confined conditions (Pers. Comm. Todd Jarvis, September 1999).

2.5 Surface Water

Surface water is present at the Site in four areas in and around the Site. First, Silver Creek flows along the west edge of the Property, over 500 feet from the main embankment. Second, the drainage ditch system surrounding the tailings impoundment seasonally collects runoff water flowing towards the impoundment and redirects it around the impoundment and into Silver Creek. This diversion ditch system also includes a pond in the southwestern portion of the Site and a ditch traversing the hillside north of the Site. Surface water is also present in the form of ponded water in the northwestern area of the impoundment, having ponded over the clay soil cover over the impoundment. Finally, very small quantities of surface water are present in the form of a seep located near the base of and near the north end of the main embankment.

Consideration of the fate and transport of the surface waters mentioned above is necessary to understand any impact that the Site may have on surface water quality in the area, including Silver Creek. Because ponded water on the impoundment is

derived solely from precipitation falling directly on the impoundment, the volume of ponded water varies from year to year. Ponded water follows several pathways or possible fates from the impoundment. Nearly all water loss can be attributed to evaporation and plant use within the pond. A small amount of the ponded water percolates through the underlying, low permeability soil cover and into the tailings. The ponded water never leaves the impoundment as a discrete surface flow.

The north diversion ditch (which flows west to east) discharges into an area east of the impoundment where water may ultimately enter the south diversion ditch system (which flows east to west) into a pond and ultimately towards Silver Creek. In the spring, surface water in the south diversion ditch has enough flow to sustain a discrete flow to Silver Creek. In the later summer when water flows are the lowest, the water flowing from the diversion ditch is difficult to trace to Silver Creek as a discrete flow. It is likely that some of the diversion ditch water evaporates and is taken up by plants. The south diversion ditch generally stops flowing only in the late summer or fall on the easternmost end of the ditch only. The south diversion ditch, however, never completely dries out so it does not appear that diversion ditch water infiltrates into the ground. Weston reports that the diversion ditch serves as a hydraulic sink and may intercept groundwater (Weston 1999 at 7). For this reason, it appears that late-season flow in the south diversion ditch is comprised of groundwater intercepted by the ditch.

Water from the small seep at the base of the main embankment flows at a very limited rate, in the range of gallons per day. The exact flow rate has not been measured and cannot be calculated without stripping significant amounts of vegetation and organic matter from around the seep area and installing a drain to collect the dispersed flow. However, it is clear that due to the low volume of water, a discrete flow is not and cannot be maintained long enough to reach Silver Creek, over 500 feet away. The small amount of water discharging from the seep is likely utilized by the surrounding vegetation or may evaporate.

3.0 PREVIOUS SITE INVESTIGATIONS

Since the 1970s, PCV, Noranda, EPA, and United Park have conducted numerous environmental investigations relating to the Site. Beginning in the 1970s, PCV conducted groundwater, tailings pond, and embankment design studies that focused on the construction of containment structures that would accommodate additional tailings. In 1980, Noranda conducted studies to determine the current condition of the impoundment and the potential for future enlargement of the impoundment. In the 1980s and early 1990s, EPA conducted studies of groundwater, surface water, and air quality to determine whether Site contaminants posed sufficiently high threats to human health or the environment to require listing of the Site on the National Priorities List ("NPL"). United Park initially conducted studies in response to EPA's proposal to list the Site on the NPL. More recently, United Park has obtained data focusing on the characterization of Site hydrogeology and surface water quality.

EPA has proposed listing the Site on the NPL on two occasions. In 1988, EPA proposed listing the Site on the NPL based on the Site's Hazardous Ranking System ("HRS") score. After considering public comments, EPA ultimately declined to list the Site. By 1992, the HRS scoring system had been revised. At that time, EPA rescored the Site and again proposed that the Site be placed on the NPL. Based on the new proposal to list the Site, the EPA Emergency Response Branch (ERB) conducted additional investigations on the Site and determined that conditions did not warrant emergency removal action. In 1994, the Agency for Toxic Substances and Disease Registry (ATSDR) in their "Preliminary Public Health Assessment Addendum on the Richardson Flat Tailings" found that the Site posed "no apparent public health hazards due to past or present exposure." They did, however, consider Richardson Flat an "indeterminate public health hazard" in the future due to the potential for residential development on or near areas where significant levels of contamination may be found. United Park's future land use plan includes provisions that residential development will not occur in these areas.

The EPA has yet to list the Site on the NPL, but the Site's listing on CERCLIS remains in effect. While no formal regulatory action has occurred with respect to the Site since the second proposed listing, United Park has continued its efforts to investigate and close the Site by improving the soil cover, maintaining the diversion ditches, and collecting surface water and groundwater data.

This section summarizes past investigation activities and existing Site data. The reports and data from these investigations are very useful in determining the scope of additional investigative activities needed to bring final closure to the Site. From 1985 to 1988 and from 1992 to 1993, the EPA conducted and reported on investigations at the Site.

Because past investigation activities by PCV, Noranda and United Park were performed without EPA oversight, the results from such investigations will be evaluated as part of, and incorporated as appropriate into, the Focused RI/FS.

3.1 Air Monitoring Investigations

Due to concerns over wind-blown tailings resulting from the cone-shaped tailings feature created by past operators, EPA conducted air monitoring investigations on two separate occasions. Due to United Park's subsequent placement of the full, vegetated clay soil cover, data from these investigations are no longer directly relevant but are reported here to support United Park's proposed study of off-Site wind blown tailings.

In 1985, when approximately 40 percent of all of the tailings on the Property had been covered with the soil cover, Ecology and Environment, Inc. ("E&E"), a contractor working for EPA, collected Site air data. Four high volume air samplers were located on or immediately adjacent to the tailings impoundment and one was located approximately one-half mile southeast of the Site. Data were collected at the Site over a five-day period and the filters from the samplers were analyzed for arsenic, cadmium, lead and zinc. A meteorologic station was installed at the Site and wind direction, air temperature, barometric pressure and relative humidity data were collected. The prevailing wind direction measured at that time was from the northwest to southeast (E&E, 1987 at 3).

According to E&Es analytical data, increases were noted for all metals measured in downwind versus upwind monitoring locations. Review of the data in Table 1 of the 1987 E&E report shows that 52% of arsenic, 92% of cadmium, 17% of lead and 14% of zinc measured on the air filters at the Site were below the laboratory's detection limits.

E&E again conducted air monitoring in 1992 at five locations. The installation of the cover within the impoundment had progressed to the point where all of the exposed tailings had been covered, with the exception of one area of tailings where salt grass and other native plant species were growing and had stabilized the tailings. These air monitoring activities showed no detectable levels of arsenic, cadmium or lead. Trace levels of zinc were detected in four of the seventeen samples collected. There are no ambient air quality standards for zinc. The significant reduction in the concentration of target analytes from these two air-monitoring programs can be explained by United Park's efforts to cover the remaining areas of the impoundment. Since 1992, all of the exposed tailings in the impoundment have been covered, including the area where salt grass was growing.

3.2 Tailings Cover Investigations

As part of the EPA ERB investigations in 1992, E&E conducted a survey of the depth of soil cover. E&E measured the depth of cover at 29 locations on a grid pattern of 400 x 400 feet. These locations are depicted on Figure 2, Appendix B. According to the E&E report (E&E, 1992at 4), a visual contrast was apparent between the soil cover and the gray colored tailings beneath the cover. X-ray fluorescence ("XRF") measurements for lead were taken at select locations to confirm the visual contrast where the distinction was not clear (see Appendix B, Table 1, for the soil cover data). E&E reported that much of the tailings either had soil or salt grass covering the exposed tailings. Generally, data from the 1992 study shows that the soil cover varied in thickness from less than six inches up to fourteen inches in depth in the areas E&E tested. E&E did not test areas of thick cover, where as much as three feet of cover were present. Of the 29 points E&E measured, only one location had no soil or salt grass present. Subsequent to E&E's work, United Park has

placed additional soil cover in this and other areas of the impoundment to improve the tailings cover and support Site closure.

As part of the recent hydrogeologic investigation by Weston (as discussed in section 3.4, below), data were collected on the soil characteristics of the tailings cover. Samples of the tailings cover soil were tested to determine classification and hydraulic characteristics. Soil cover samples were collected from three representative locations over the Site and were tested for moisture content and dry density. Based on this testing, the soil cover was classified as lean clay with sand. Two of the three samples were also submitted for laboratory analysis to determine permeability. Laboratory testing indicated that the cover soil is highly impermeable, with permeabilities ranging from 3 to 7×10^{-8} cm/sec. These values roughly correspond to permeabilities typically measured in clay liner systems that are required to be installed at hazardous waste landfills. X-ray diffraction ("XRD") analysis of select samples indicated that the soil cover clay mineralogy closely matched the XRD peaks for illite and kaolinite. Kaolinite was the most prevalent clay mineral and it is stable with little tendency for volume change when exposed to water. Illite is generally more plastic than kaolinite and does not expand when exposed to water (Weston 1999 at 4).

3.3 Studies of Tailings Impoundment Integrity and Stability.

In 1974, PCV hired Dames & Moore to conduct an investigation of the Site and to develop construction specifications for reconstruction of the embankment in order to accommodate the placement of additional tailings materials. While PCV raised and reconstructed the embankment and installed the containment dike system, according to subsequent work performed by Dames & Moore for Noranda, PCV did not appear to follow the design specifications developed by Dames & Moore. In 1980, Dames & Moore conducted an impoundment integrity and stability investigation for Noranda, the then-current operator of the Richardson Flat tailings impoundment. The objective of that investigation was to assess the overall condition and usefulness of the existing facilities and

to determine what measures would be required for long-term tailings disposal (Dames & Moore 1980 at 1). Dames & Moore noted several construction flaws during the 1980 investigation, specifically noting that the main embankment was oversteepened in some locations. Dames & Moore concluded that while it did not have any immediate concerns regarding the stability of the main embankment and containment dikes, it did have concerns regarding the use of the Site to dispose of additional tailings.

In 1992, E&E examined the tailings impoundment for EPA. Although E&E noted that the main embankment generally was not constructed according to the 1974 recommendations of Dames & Moore, E&E concluded that there appeared to be no immediate threat of gross failure of the tailings containment structure.

3.4 Groundwater Investigations

In the early 1970s, PCV began to collect groundwater data at the Site. Since that time, both EPA and United Park have investigated groundwater conditions at the Site. In 1973, PCV installed three monitoring wells (MW-1, MW-2 and MW-3) at the bottom of the main embankment. In 1976, PCV installed three additional wells (MW-4, MW-5, MW-6). Figure 3.3 shows the well locations. It appears that PCV buried monitoring well MW-2 in 1976 during installation of the three new wells. Thus, five groundwater monitoring wells are located near the toe of the embankment. The boring and well completion logs for these five wells can be found in Appendix D and are summarized below.

- MW-1 was drilled to a depth of 35 feet below the ground surface ("bgs"). Bedrock was encountered from 14.5 feet bgs to the total depth drilled. Well screen and gravel pack were installed from 24 to 34 feet bgs.
- MW-2 was drilled to a depth of 21 feet bgs; bedrock was encountered from 11 to 21 feet bgs. Well screen and gravel pack were installed from 3 to 9.5 feet bgs. (This well was destroyed during the installation of MWs-4 through 6 in 1976).

- MW-3 was drilled to a depth of 29 feet bgs; and bedrock was encountered from 5.8 to 31 feet bgs. Well screen and gravel pack were installed from 2.5 to 25 feet bgs.
- MW-4, MW-5, and MW-6 were drilled to 4.0 feet, 6.1 feet and 6.1 feet bgs, respectively. Boring and completion logs for these wells are not available.

Since 1973, PCV, and later, United Park, have collected data quarterly from these embankment wells. Table 3.2 presents groundwater data collected by United Park from 1982 to 1987 and 1991 to 1998 from these monitoring wells.¹ Data presented in Table 3.2 shows that the water quality has steadily improved in the monitoring wells generally over time. However, there are some anomalies that are readily apparent. For instance, in September of 1998, pH levels between 2.7 and 4.1 were noted for MW-4 and MW-5, respectively. Although these are relatively low pH values and could be indicative of a change in water chemistry in these two wells, it is interesting to note that dissolved zinc concentrations measured in MW-4 for the same time period were an order of magnitude lower than for the measurement in June of 1998 when the pH was 7.1. In MW-5, the dissolved zinc concentrations were similar between June and September of 1998 and the pH values were 7.7 and 4.1, respectively. Both of these wells are completed within the first six feet of the ground surface. Thus, it is likely that the water that is monitored here is vadose zone water that is highly oxidigenated. The oxidigenated water will have a highly variable water chemistry depending on the hydrogeologic characteristics of the subsurface soils. A definitive trend in the water chemistry is not apparent. As part of additional studies planned for the Site, United Park will review the historical data and determine the suitability of wells MW-4, MW-5 and MW-6 as groundwater monitoring wells. In 1985,

¹ Groundwater data from the main embankment wells for the years 1988 to 1990 are not readily available to United Park and as a result are not reported herein. United Park is attempting to locate data from 1988 to 1990, if it is located, and will report it as part of the RI/FS Report, discussed below.

E&E collected groundwater samples from one upgradient well and two wells located downgradient of the main embankment.² E&E installed the upgradient RT-1 monitoring well. The two downgradient wells were existing wells installed by PCV around 1974 and 1975.³

In 1992, EPA hired E&E to conduct an additional groundwater investigation. The 1992 groundwater data collected revealed a similar trend as shown in the 1985 E&E study. E&E collected groundwater samples from the Site at three locations, referred to as RF-GW-04 (EPA well RT-1), RF-GW-05 (United Park location MW-1) and RF-GW-09 (United Park location MW-6). Table 3.3 compares the data collected by EPA in 1984 and 1992 with data collected from the same wells by United Park in 1998. Review of the data collected from RT-1 in 1984 and 1992 reveals that water quality appears to have deteriorated at this location over time. Some dissolved metal concentrations have increased from 1984 to 1992. The 1992 data contains some anomalies that suggest either the sample was contaminated or there were some analytical errors; dissolved metal

² According to the E&E sampling report, United Park wells MW-1 and MW-2 were sampled. However, this was not the case: MW-1 was most likely sampled and MW-5 or MW-6 were sampled since MW-2 was believed to have been buried during the installation of MW-4, MW-5 and MW-6 (see Plate 1, Appendix A). United Park's 104(e) response to EPA in 1988 did not contain data for MW-2. The data record submitted to EPA covered the time period from 1982 to 1987. Therefore, E&E could not have sampled MW-2 at that time.

³ While E&E compared the upgradient and downgradient metals concentrations in order to determine if the tailings materials were impacting groundwater beneath the impoundment, comparison of this data is not appropriate. Further analysis of the well completion logs for RT-1 and MW-1 compared to the total depth of wells MW-5 or MW-6 reveals that RT-1 was screened in both the upper and lower shallow aquifers. MW-1 is screened in the bedrock aquifer and wells MW-5 and MW-6 are screened in the vadose zone. Comparing data from these wells is not accurate since all the wells are completed in different aquifers. E&E reported that downgradient metals concentrations were elevated as compared to upgradient concentrations. However, in 1985, only manganese exceeded National Interim Primary (NIP) drinking water standards. (E&E 1985).

concentrations are greater than the total for antimony, copper, and silver. The change in water chemistry over the eight-year time period is difficult to explain at this time. The well is completed in two aquifers, and thus, there is likely a mixing of water between the two water bearing zones. During site visits in early 1999, it had been observed that the wellhead integrity had been compromised, apparently by vandals. It is not known if this damage had occurred in 1992. As a result, surface contamination may have impacted water quality. The well was installed by E&E in 1984, and therefore, is the property of the EPA. United Park does not sample this well. United Park believes that the well should be abandoned according to proper procedures because of the intermixing of the two aquifers and the breach in the wellhead integrity.

In 1999, United Park hired Weston Engineering, Inc. ("Weston") to conduct a supplemental hydrogeological investigation of the Site. This study represented the most extensive groundwater investigation conducted to date to better understand groundwater systems on the Property. Weston evaluated historical Site and regional data to derive a hydrogeological conceptual Site model (see Appendix A). In the course of its investigation, Weston also installed eleven additional piezometers throughout the Property (see Plate 1, Appendix A). Boring logs from the piezometer installation verified the existence of two aquifers associated with the Property. Water level data collected from the piezometers indicates that the two aquifers are confined and are separated from one another by a significant layer of stiff, clay-rich material. The upper aquifer is overlain by approximately 15 feet of reddish-brown mixtures of silt and clay. An additional two to five foot layer of clay-rich soil overlies this layer of clay-rich material (Weston, 1999, at 4). The local geology has greatly influenced the types of soils that have developed on the Property. The altering and weathering of Keetley volcanics, which form the surrounding hills, have provided the source material for soil development. The abundant clays that result from the alteration and weathering of the Keetley volcanics form the bulk of the natural alluvial material as well as the soil within the Property. Percolation tests conducted on this volcanic soil that was borrowed to cover the tailings within the impoundment indicates that

it has very low permeability, $3 \text{ to } 7 \times 10^{-8} \text{ cm/sec}$. Water level data collected after the installation of the piezometers and subsequent water level measurements indicate that the water levels in the two aquifers varies seasonally, with higher water levels occurring in the Spring.

The data reported by Weston was not available to earlier Site inspection teams and other agencies that previously evaluated the Site. Studies by Dames & Moore identified the presence of clays in the naturally-occurring material at the Site. It was not until Weston's investigation that the extent and significance of the natural clay material underlying the Property was known. The existence of two to five feet of clay-rich topsoil and the presence of the large area of silt and clay that overly the upper aquifer represent a significant barrier to the vertical migration of any water from saturated tailings.

3.5 Investigations of Surface Water Quality

United Park has collected surface water quality data at the Site since 1975. Data from 1982 to 1988 are presented in Table 3.1. Samples were collected from locations upstream and downstream of the confluence of the south diversion ditch with Silver Creek. Also, samples were collected from water that runs in the diversion ditch as it passes through the Site. Figure 3.1 shows the sample locations.

A review of the historical and recent data from these three sampling points demonstrates that since the time that United Park's re-grading and covering of the banks of the south diversion ditch (1992-1993), water quality has steadily improved both in the south diversion ditch at the point where it leaves the Site and in Silver Creek below the Site (*See Figures 3.2 and 3.2a*). The data also demonstrates that although some metals are present in upgradient areas in the south diversion ditch, by the time the water discharges to Silver Creek, metal levels have decreased significantly.

In 1999, United Park initiated a surface water sampling program designed to characterize water chemistry in the south diversion ditch and Silver Creek near the Site. Table 3.4 presents the data collected in 1999; Figure 3.3 shows the 1999 sample locations;

and Table 5.2 lists the analytical parameters that were measured in surface waters in and around the Site. Samples were collected at eleven locations in May and June of 1999 during the spring snowmelt and runoff season (designated RF-1 through RF-10 on Figure 3.3). Samples were collected and analyzed for full suite parameters as shown in Table 5.2 at RF-1 and RF-3 (See Figure 3.3) on the unnamed drainages that flow into the south diversion ditch. Samples were collected in May and June of 1999 at RF-2, RF-4, RF-5 and RF-6 on the south diversion ditch. Samples RF-2 and RF-6 were analyzed for full suite parameters and RF-4 and RF-5 were analyzed for total and dissolved metals. Samples RF-7, RF-7-2, RF-8 were collected from Silver Creek and analyzed for full suite parameters. Location RF-9 is the ponded water that exists on the tailings impoundment this sample was analyzed for full suite parameters. Sample location RF-10 represents background water quality from the south unnamed drainage near the county road along the eastern boundary of the site. RF-10 was sampled one time and will not be sampled in the future. Sample locations RF-3 and RF-3-2 will replace RF-10. Samples were collected monthly at three locations (RF-6, RF-7-2 and RF-8) from July to November of 1999. Full suite analyses consisted of major cations and anions, metals and field parameters. Target metals were arsenic, cadmium, chromium, copper, lead, mercury, selenium, silver and zinc. Field parameters were flow, pH, conductivity and temperature.

Table 3.4 presents the 1999 data in three categories. The first category compares the data to aquatic wildlife criteria, the second category gives the general water chemistry data, and the third category compares the data to water quality standards for a Class 1C stream (this is the classification for Silver Creek). The aquatic wildlife standard is based on hardness in the water. Therefore, the standard will have a different value depending on hardness at each location. Metal data presented in the first category are compared to hardness-dependent aquatic wildlife criteria. Protection of Aquatic Wildlife Criteria is the most stringent regulatory standard for comparison purposes. In other words, if the metal concentration is less than the aquatic wildlife criteria, then that metal concentration will be less than the applicable water quality standard. Examination of the

first category of data presented in Table 3.4 reveals that for all of the metals measured only zinc and mercury exceed the aquatic wildlife criteria. Zinc exceeds both the acute and chronic criteria in samples collected upstream in Silver Creek (RF-7 and RF-7-2) and downstream (RF-8) of the south diversion ditch confluence. Zinc concentrations measured in the diversion ditch (RF-6 and RF-6-2) are well below the aquatic wildlife criteria.

Mercury concentrations measured in 1999 were all below the laboratory detection limit of 0.0005 mg/l at all of the sample locations. The acute aquatic wildlife criteria is 0.0024 mg/l and the chronic criteria is 0.000012 mg/l. Therefore, measured mercury concentrations were below the acute criteria. EPA recently promulgated laboratory method 1631 that establishes a standardized procedure to measure mercury at the 2-3 part per trillion range.

4.0 PRELIMINARY SITE MODEL

Based on previous and current environmental studies and existing Site conditions, Respondents have developed a preliminary model of the Site. A Conceptual Site Model will be developed in coordination with EPA's toxicologist using information presented in the preliminary site model. The Conceptual Site Model will also be used to assist in the evaluation of the appropriateness of the existing remedies and, to the extent necessary, in the development of additional remedial measures to support final Site closure. The preliminary site model has been developed to portray existing site conditions and more recent data and information that have been developed by United Park. The preliminary site model is described below and graphically portrayed in Figure 4.0, and will be used to evaluate the need for additional Site characterization work to be performed as part of the Focused RI/FS. After the Conceptual Site Model is derived, it will be updated and refined as additional data are gathered during the Focused RI and, with input from EPA, will be used to support EPA's preparation of the baseline risk assessment.

4.1 The Tailings Impoundment

The tailings impoundment can be visualized as a semi-rectangular shaped, geometrically closed basin, with a man-made main embankment on the west edge and perimeter containment dike system along the south and east sides and a sloping natural surface forming the fourth side. *See Figure 2.0.* The main embankment is located along the western dimension of the impoundment. The tailings impoundment structure isolates and contains variably thick, slimy and sandy mill tailings materials. The impoundment is covered with high clay-content, vegetated soil. The tailings have been deposited on thick layers of native, clay-rich soils. Metals present in the tailings material are the primary potential sources of contaminants at the Site. Geochemical data collected during air monitoring conducted in 1984 by E&E for the EPA characterize the tailings as metal sulfide materials. Such compounds, when found in a neutral pH environment such as exists at the Site, are not easily degraded and are particularly stable. As appropriate, modeling techniques may be used during the FS to evaluate the long-term chemical stability of the materials within the impoundment to support final closure of the Site

The clay-rich soils underlying the impoundment formed the original ground surface topsoil materials that existed at the Site prior to the deposition of the tailings. Permeability data reported by Weston indicate that these underlying clay soils have a low hydraulic conductivity, ranging from 0.001 to 5 ft/year. The clay soil cover materials have permeabilities ranging from 0.031 to 0.072 ft/year (Weston, Table 1, page 7, 1999). A diversion ditch system prevents most storm water from entering the impoundment from off-Site sources, as explained more fully below in Section 4.3.

4.2 Other Tailings Materials

Some tailings materials are present outside and to the south of the current impoundment area. During historic operations of the tailings pond, tailings materials of varying thickness accumulated in three naturally low areas leading to the property that eventually became the impoundment.

In the 1970s, when PCV constructed the perimeter dike and diversion ditch along the south perimeter of the impoundment, tailings present in the three low areas were left in place, outside of the present impoundment. Starting in 1983, United Park covered most of these tailings outside of the current impoundment with the same kind of low permeability, vegetated soil cover United Park also placed over the tailings impoundment. Other types of clean fill material, imported from construction work in Park City, was also used to cover the tailings outside of the impoundment. Because these areas were naturally low, the cover in some of these areas is as thick as 10 to 15 feet. Data from the Weston Report indicates that the same underlying, natural soil conditions exist in these locations as beneath the impoundment.

As explained more fully in Section 5.2, below, United Park will estimate the areal and vertical extent of tailings outside of the impoundment. United Park will also study any adverse impacts the tailings materials may have on surface water in the south diversion ditch. With this information, United Park will evaluate the necessity and the feasibility of excavating these off-impoundment tailings and cover materials and placing the same within the impoundment.

4.3 Surface Water

As noted above, surface water is present in four areas in and around the Site. First, Silver Creek flows along the west edge of the Property, over 500 feet from the main embankment. Second, the drainage ditch systems surrounding the tailings impoundment seasonally collect runoff water flowing towards the impoundment and redirect it around the impoundment and towards Silver Creek. Surface water is also present in the form of ponded water in the northwestern area of the impoundment, having ponded on the surface of the clay soil cover. Finally, very small quantities of surface water are present in the form of seeps located near the base of and near the north abutment of the main embankment.

Ponded water on the surface of the soil cover within the impoundment is derived solely from precipitation falling directly on the impoundment. The amount of

water ponding on the surface of the impoundment varies from year to year. Pondered water follows several pathways or possible fates from the impoundment. Nearly all water loss can be attributed to evaporation and plant use within the pond. A small amount of the pondered water likely percolates through the underlying, low permeability soil cover and into the tailings. The pondered water never leaves the impoundment as a discrete surface flow. It is highly unlikely that surface water would ever fill the basin within the impoundment. Even if large amounts of water ended up on the impoundment for some unlikely reason, studies indicate that the area within the impoundment has sufficient capacity or "freeboard" to contain the 100-year/24-hour precipitation event, thus eliminating the possibility of overtopping (Dames & Moore, 1980 at 12, Alliance Engineering 1999). But even if the tailings impoundment were to ever overfill with water for some unlikely reason, excess water would flow to the lower, east end of the containment dike system, near the east end or point of origin of the south diversion ditch system. Water from an overtopping event would not flow west across or cut into the main embankment.

The north diversion ditch (which flows west to east) discharges into an area east of the impoundment where water may ultimately enter the south diversion ditch system (which flows east to west) towards Silver Creek. Water from the south diversion ditch flows west and collects in a pond located in a historic excavation where materials were removed for use in the construction of the main embankment during 1973-74. The grade of the south or main diversion ditch is low, and therefore, the velocity of water flowing through the ditch does not carry enough energy to erode the channel. Where higher water velocities do occur in the ditch, rip-rap or vegetation is present to minimize any potentially-adverse impacts to the ditch banks due to erosion. The ditch is well-vegetated by common wetland species such as cattails and willows. This vegetation helps to buffer the banks from erosion and also serves to decrease water velocity, thereby eliminating potential erosion problems.

In the spring, surface water in the south diversion ditch has enough flow to sustain a discrete flow to Silver Creek. In the later summer when water flows are the

lowest, the water flowing from the diversion ditch is difficult to trace to Silver Creek as a discrete flow. Some of the diversion ditch water evaporates and is taken up by plants. As noted above, the south diversion ditch never completely dries out and it does not appear that diversion ditch water significantly infiltrates into the ground. If the diversion ditch is acting as a hydraulic sink, it may be intercepting groundwater.

The seep at the base of the main embankment generates a very small flow of water, in the range of gallons per day. Due to the low volume of water, a discrete flow is not and cannot be maintained long enough to reach Silver Creek, over 500 feet away. The existence of the seep is consistent with the design of the tailings impoundment. As noted above, the main embankment was designed to allow seepage as necessary in order to alleviate the build-up of hydraulic pressure from within the impoundment. No data indicate or even remotely suggest that a potential soil piping failure may occur at the point of the seep. The physical characteristics of the seep have remained constant since it was first observed at the Site. Seepage water has not been observed to carry sediment and has been occurring at a very low flow rate that has not increased over time.

While seasonal runoff water from the south diversion ditch reaches Silver Creek during the spring and summer months of the year, United Park believes the data establish that water quality in the south diversion ditch has been steadily improving for the past decade. This has been clearly evident after United Park completely covered the tailings inside of the impoundment and re-graded and covered the banks of the south diversion ditch in 1992. This trend toward improved water quality not only reflects United Park's remedial efforts taken at the Site, but also the change in Site conditions from the more dynamic status as an operating tailings pond (receiving hundreds of thousands of gallons of water and thousands of tons of tailings per week) to a large parcel of land that only receives water from snow melt or rain. However, additional characterization of the water and wetlands in this ditch will be performed to address the long-term ability of the wetlands to continue to improve water quality. The scope of the additional characterization is discussed in Section 5.4.

In addition, recent water quality data provides sufficient parameters upon which United Park has evaluated the impacts of the tailing impoundment on Silver Creek water chemistry. United Park has used existing data in a simple mixing calculation to: (1) determine if discharges from the diversion ditch are impacting Silver Creek and (2) if such impacts are occurring, then determine what further detailed modeling and data requirements would be required to examine the impacts to Silver Creek. The mixing “model” is described in detail in Appendix C. This model has essentially calculated waste loads to Silver Creek from the diversion ditch and embankment seeps under four different scenarios. First, it is assumed that Silver Creek meets ambient water quality (“AWQ”) standard for zinc. Modeling is then completed on the diversion ditch and the main embankment seep to determine what the metals loading in these two sources of water would have to be in order to assure that Silver Creek does not exceed standards. Second, modeling is done using actual values for both the seep and diversion ditch. The actual metal concentrations in Silver Creek are calculated in this scenario. The third scenario makes the assumption that Silver Creek contains no zinc or 0.00 mg/l. The fourth scenario assumes that most of the loading from tailing impoundment is eliminated.

Using available data, the calculations establish that any metal load contributions made by the south diversion ditch and, potentially, by the main embankment seep, do not adversely impact Silver Creek, even when Silver Creek is presumed to contain no metals. Stated differently, the load contribution to Silver Creek from the south diversion ditch (and to the extent relevant, from the main embankment seep) is not significant enough to cause an effect on the quality of water in Silver Creek. The contribution of the low metal concentrations from the Site do not cause Silver Creek to exceed surface water quality standards for the State of Utah, even if it is presumed that Silver Creek contains no metal. In summary, by utilizing waste-load calculations similar to those used on an NPDES permitted discharge, it can be shown that the south diversion ditch and main embankment seep do not have enough flow or metal loading to cause Silver Creek to exceed water quality standards. United Park recognizes that water quality in

Silver Creek does not meet the standards for a variety of uses. However, United Park believes that zinc concentrations observed in Silver Creek are not a result of waters flowing from the south diversion ditch and the main embankment seep from the Site. Through the RI/FS process, this modeling will be updated with newly acquired data and reevaluated, as appropriate, to assure that it is representative of existing conditions.

4.4 Groundwater

Recent and historic data establishes that there are at least four shallow groundwater systems associated with the Richardson Flat area :

- The impounded tailings
 - Relatively shallow alluvium with possibly a perched water table
 - Deeper alluvium composed of confined sand and gravel aquifer(s)
 - The underlying and adjacent fractured Keetley volcanic rocks
- (Weston 1999, at 2).

Tailings were initially placed on native, clay-rich topsoil that was the original ground surface prior to the deposition of tailings. (Weston, 1999; *see* Figure 3.0). Water is also present in the tailings from the tailings slurry transport system and the limited percolation of storm water and snowmelt through the existing soil cover. The underlying low permeability clayey soils effectively create a barrier to the vertical movement of groundwater from the tailings impoundment to the underlying shallow alluvial or bedrock aquifers. (Weston 1999, at 6).

Within the immediate area of the impoundment, groundwater flow in the bedrock aquifer monitoring well (MW-1) is reported as quite low. (Dames & Moore, 1973 at 4). Based on limited but useful data, the groundwater flow in the deeper volcanic bedrock aquifer does not appear to be significant, either. Weston reported (*see* Appendix A, page 3) that a test well located approximately one mile northwest of the Site was completed to a depth of 1,000 feet into the volcanic bedrock aquifer. The well produced

insignificant water for use as municipal water supply. Transmissivities ranged from 30 to 50 ft² /day for this well. (Weston, 1999, at 3).

4.5 Identification of Potential Contaminant Migration Pathways

Based on data collected to date, Respondents have identified three potential contaminant migration pathways. First, releases to the air as the result of wind-blown dispersion of tailings materials occurred in the past. This pathway has been eliminated because the tailings within the impoundment are covered with a soil and vegetative cover. Existing data suggests that the high clay-content soil cover is relatively impermeable, is stable, and is suitable to prevent direct contact with, and wind dispersion of, the underlying tailings materials. United Park proposes to conduct additional field work to confirm the thickness and effectiveness of the soil cover in order to determine whether additional remedial measures are needed to achieve final site closure, as described in more detail in section 5.2, below.

Second, Respondents understand that EPA has raised concern over potential releases to groundwater as the result of leaching metals from the tailings and hydraulic connectivity between saturated tailings and Site groundwater systems. Tailings materials and the substances leached therefrom would be the primary source of potential contamination to the groundwater. The potential exposure route for terrestrial or aquatic biota would be ingestion of surface water that has been affected by contaminated groundwater.

This second potential contaminant migration pathway is inconsistent with existing, natural Site conditions. Low-permeability, native clay soil is continuous beneath the impoundment, as illustrated in Figure 4.0. Mineralogical data on the underlying soils indicate that the clay layer is comprised of a mixed clay mineral (i.e., mixed mica and illite or smectite). Based on recent studies by Weston, Respondents believe that existing data establishes that it is unlikely that leached metals would migrate through the significant clay soil layer and into the underlying shallow aquifer because of the low permeability of the

soil layers underlying the tailings. The tailings are derived from mineralized bodies that are hosted in carbonate or carbonate-rich rocks. These materials have a high buffering ability to counter any acid that might form as the result of sulfide degradation. Finally, there are no drinking water wells completed in the shallow or deep alluvial aquifers on or near the Site. Additional efforts will be undertaken as part of the Focused RI to further confirm this as discussed in Section 5.5 below.

The third potential contaminant migration pathway consists of releases to surface water as the result of leaching of metals from the tailings materials. As with groundwater, tailings materials are the primary potential source of contamination of surface water. With the possible exception of the bottom of portions of the south diversion ditch and the small amount of water discharging from the seep at the base of the main embankment, surface water does not come into direct contact with the tailings materials. While a potential contamination pathway to surface water exists in portions of the south diversion ditch and in the seep at the base of the main embankment, existing data also suggests that neither pathway is having any adverse impact on the water quality or the general water chemistry, including zinc concentrations, in Silver Creek. Nevertheless, United Park will conduct additional surface water characterization work to further evaluate the condition of the southern diversion ditch and to evaluate any impacts caused or potentially caused through the surface water contaminant migration pathway, as described in more detail in section 5.4 below.

5.0 SUPPLEMENTAL REMEDIAL INVESTIGATION WORK

As summarized in Section 3.0 above, extensive investigation work has already been completed at the Site. Moreover, over the years, United Park and others have taken actions to support final closure of the Site, including the installation of a soil cover over the tailings, drainage ditches, and a security fence. In order to evaluate the need for any further remedial measures to support final Site closure and to assure that the existing remedies in place are adequate and have longevity, United Park proposes conducting the

following remedial investigation work. This Section describes and discusses the rationale and scope of the proposed work, including a description of applicable data quality objectives.

5.1 Tailings Cover Investigation

Since 1983, United Park has been placing soils over the impounded tailings in an effort to control wind-blown dust from exposed tailings. The tailings are now entirely covered with a vegetated, clay soil cover. Additional studies on the tailings cover will gather data to support evaluation of the following: (i) the minimization of surface water infiltration into the tailings embankment; and (ii) the adequacy of existing cover to support final site closure, consistent with contemplated future redevelopment of the Site and the adjacent Property. To that end, Respondent will gather sufficient supplemental data in order to meet the following objectives:

- Confirm the lateral and vertical extent of the existing tailings cover;
- Determine the technical specifications for any additional cover, if needed;
- Determine the specifications for suitable borrow material;
- Determine revegetation requirements, if needed;
- Determine surface grading requirements to improve drainage, if needed; and
- Evaluate whether or not there are any unacceptable health risks associated with potential exposure to the tailings cover materials.

Respondents will confirm the lateral and vertical extent of the soil cover by using data collected by E&E in 1992 as a baseline and collecting new soil samples on a 500 by 500 foot grid. Following procedures similar to those E&E used in 1992, Respondents will dig shallow excavations either with shovels, hand augers or backhoes, if necessary, until the tailings are exposed. Visual observations of the contact between the cover soils and

tailings will be used to document the depth of the soil cover at each grid point. The tailings materials are sufficiently different in grain size and color from the cover materials to permit use of a visual identification method to differentiate between tailings and the soil cover. The cover soils are characteristically identified as a reddish-brown clay material while the tailings are characterized as a gray silty-sand material. Verification of the visual method will be conducted by collecting samples at ten-percent of the sample points and submitting them for laboratory analysis. The samples will be collected from the cover material at the surface (0 to 1 inch) (such that EPA can assess potential health risks as a result of exposure to such cover materials) and just above the tailings interface (to assess the vertical extent of the tailings cover). The samples will be analyzed for metals noted in the Analytical List for soils shown in Table 5.2. Figure 5.0 shows the sampling grid, and Figure 2 in Appendix B shows the 1992 sample locations. Respondents will undertake additional work, as necessary, if the findings from the proposed work prove to be insufficient to meet the above-mentioned objectives. A Sample and Analysis Plan (SAP) that specifies the sample and analytical methods for this and subsequent work described in Section 5.0 will be submitted to EPA within 60 days of the effective date of the AOC.

Based on the results of the sampling and evaluation of health risks, if any, Respondents will evaluate (i) the need for additional cover material to supplement existing cover (including but not limited to evaluation of soil type, thickness, permeability, and compaction requirements); (ii) vegetation and revegetation requirements; and (iii) surface drainage requirements.

5.2 Off-Impoundment Tailings Investigation

Tailings are present in three naturally low areas south of the present south perimeter containment dike and south diversion ditch. See Figures 2.0 and 3.3. Respondents propose to use historical aerial photographs to determine the areal extent of off-impoundment tailings materials. Respondents will also estimate the vertical extent of tailings and cover material using existing historical information and limited borehole data.

Respondents will also study whether or not shallow groundwater is moving through these tailings and is potentially intercepted by the south diversion ditch. At a minimum, United Park will install three (3) borings in the low lying areas in locations shown on Figure 3.3. The borings will be drilled down to the tailings/soil interface. If groundwater is encountered, the borings will be converted to monitoring wells. Data from the borings will be used to determine the thickness of tailings. Additional borings may be installed to better define the lateral and vertical extent of the off-impoundment tailings, if additional information is required. Such additional information may be necessary if it were determined that these tailings are adversely impacting the ground or surface water quality so as to require removal of the tailings. A surface water elevation datum will be installed at the south diversion ditch near RF-4 in the event that the monitoring wells are installed. Groundwater elevations in the monitoring wells would be compared to the surface water elevation measured near RF-4 to better quantify and qualify the interaction between the two systems. Respondents will use this additional data to determine the approximate volume of tailings located south of the impoundment, and whether these tailings are having any potential, adverse impact on the water quality in the south diversion ditch. Respondents will further use this information to determine whether or not the tailings presently located to the south of the impoundment need to be excavated and placed within the impoundment. This will include an estimation of the costs of excavation of the off-impoundment tailings (and associated cover), placement of the same within the impoundment, and installing additional soil cover as needed. Should these studies indicate that the tailings located south of the impoundment must be relocated, Respondents will also evaluate the potential geotechnical impacts excavation may have on the containment dikes along the diversion ditch, as well as the main embankment.

5.3 Wind-Blown Tailings

As previously discussed, prior to United Park's placement of a soil cover over all of the tailings, some of the tailings material may have been blown by the wind to areas near the Site. The areal extent of any wind-blown tailings has not been fully addressed in prior studies. EPA has requested that, as part of the remedial investigation work, Respondents evaluate such wind-blown tailings.

Respondents will gather sufficient data in order to meet the following objectives:

- Confirm the lateral and vertical extent of the wind-blown tailings; and
- Evaluate whether or not there are any unacceptable health risks associated with potential exposure to the wind-blown tailings.

Respondents will conduct soil sampling at select locations along three sampling transects. Sampling transects, 3,500 feet long, will be established in field with the following criteria:

- One sample transect will be placed perpendicular to the tailings impoundment, approximately 500 feet north of the main embankment.
- Two sample transects will be placed beginning 500 feet south of the county road and a second transect at a 500-foot interval.

The sampling transects locations were determined by utilizing information in E&E's report on air monitoring activities in 1986. Sample transects are placed perpendicular to observed site wind directions. E&E reported that the prevailing wind direction in Park City is from the southeast. Review of the Site wind direction data recorded by E&E confirms that the prevailing wind is from the southeast with lower velocity winds from the northwest occasionally. (E&E, 1986, at 3)

Respondents will collect soil samples at 500-foot intervals along the transects and at depths of 0-1 and 1-6 inches. The samples will be analyzed for the soil parameters listed in Table 5.2. Figure 6.0 shows the proposed location of the transects and sample intervals. Respondents will undertake additional work, as necessary, if the findings from the proposed work prove to be insufficient to meet the above-mentioned objectives. Data collected from wind-blown tailings will be used by EPA to assess potential health risks, if any, associated with exposure to such tailings, and, if necessary, determine whether any remedial action will be required.

5.4 Surface Water

Surface water is present at and near the Site, primarily in the south diversion ditch system and in Silver Creek. As noted above, elevated metal concentrations have been detected in the south diversion ditch, which not only decrease in concentration as the water flows towards Silver Creek but overall have also decreased in concentration during the last several years. Despite significant existing surface water quality data, previous surface water quality investigations did not analyze sufficient parameters to be useful in United Park's metal loading model. Additional surface water data will be collected specifically to determine impacts to Silver Creek from the Site surface waters. Expanded surface water characterization data will be gathered to determine whether the data varies with changing seasons. Respondents will also collect a series of sediment samples from the south diversion ditch to more accurately characterize the potential source of zinc in the south diversion ditch water quality samples. Samples will be collected and analyzed according to procedures that are discussed in detail in the SAP. The sediment samples will be analyzed for metals parameters listed in Table 5.2. Data from the sediment samples will be used to determine the long term fate and transport of metals in the Site wetland areas. Wetlands in the diversion ditch contain similar vegetation and sediments as wetlands present between the main embankment and Silver Creek.

Based on surface water data collected in 1999, presented in Table 3.4, and a review of historic aerial photographs, it appears that the diversion ditch channel bed may be constructed in tailings in the area just upstream and downstream of the RF-4 sample location (*See Figure 3.3*). In order to isolate potential source areas, six sediment samples will be collected at 500-foot intervals between sample locations RF-2 and RF-5. Water quality data presented in Table 3.4 indicates that zinc is the primary metal that is either solubilizing in the sediments or is leaching into the diversion ditch via a groundwater pathway. In addition, the long-term viability of the wetland system to continue to enhance water quality will be evaluated. This will include an evaluation of the existing biological system, identification of metal removal mechanisms, fate and transport of metals in the wetland system, and a discussion of the operation and maintenance of the diversion ditch.

In addition, more precise water flow information is needed for the “mixing model”. To gather precise flow information, United Park has recently installed a twelve-inch parshall flume on the south diversion ditch downstream of the pond. The flume will be used to measure flow in the diversion ditch upstream from the location where it enters the wetland area and Silver Creek (location RF-6). Two smaller flumes, nine inches at the throat, were installed at upstream locations on the south diversion ditch (RF-2 and RF-3-2). Flow measurements in Silver Creek will be determined just upstream of sampling station RF-7-2 by using a current meter and standardized measurement methods for open channel flow determinations. Flume installation on Silver Creek proper is difficult due to a variety of issues outside of Respondents’ control. Accurate flow information cannot be gathered at the downstream confluence of Silver Creek and the diversion ditch due to dispersed flow through the wetland area. Water flow at RF-8 in Silver Creek will be determined by adding the flow measured at RF-6 and RF-7-2. Figure 3.3 shows the flume locations.

Insufficient data currently exist to determine whether the metals loading modeling that Respondents have developed adequately characterizes conditions throughout a complete year. Future water sampling will be collected to complete the existing database.

Respondents will submit a report to EPA that summarizes data collected from May of 1999 to date. The report will be submitted with the RI report. The surface water monitoring program will be performed to collect water samples on a monthly basis at the following locations: RF-2, RF-3-2, RF-6, RF-7-2 and RF-8 (see Figure 3.3). As shown in Figure 3.3, RF-3 has been replaced with a new location, RF-3-2, to allow for flow measurement from the parshall flume. Surface water samples will be analyzed for the water parameters listed in Table 5.2. After sufficient data have been gathered, Respondents' "mixing model" will be refined using the new information. The modeling will be reevaluated with newly acquired data to assure that it is representative of existing conditions.

While more precise flow rate data from the main embankment seep may be useful, a significant amount of existing vegetation and organic matter, grown during the last ten years or so, would have to be removed before flow data can be obtained. Because Respondents believe that the existing natural conditions are very likely mitigating any dissolved metals present in the water from the seep, Respondents are reluctant to propose disturbing existing conditions at this time, unless the proposed wedge buttress design requires this information. The seep does not generate a significant volume of water. In fact, it is quite difficult to detect flow water; hence the identification as a seep. Water chemistry from this location is quite likely to be of little use other than to identify the potential source of the water. Nevertheless, Respondents will collect a sample from the main embankment seep area in order to better characterize water quality and concentrations of dissolved metals. The sample will be analyzed for the water parameters listed in Table 5.2. If additional data regarding the seep is necessary in connection with the design of the proposed wedge buttress, Respondents will collect data for that purpose.

5.5 Groundwater

The hydrogeologic conceptual model prepared by Weston will be used as the basis of further work on refining the understanding of groundwater conditions at the Site. As part of its study, Weston installed 11 new piezometers. Groundwater elevation data is

currently collected on a monthly basis to determine whether seasonal groundwater fluctuations exist. This sampling will occur through another runoff cycle or until the end of the last quarter of 2000. The data from these measurements will help determine the relationship between the shallow aquifers, the tailings impoundment and Silver Creek alluvial groundwater. A report will be drafted upon completion of the data collection process that addresses any changes in the groundwater levels.

As noted by EPA in its informal review of the Weston report, additional information is required to refine the Site's water balance. Monthly water levels will be collected from the piezometers installed by Weston in and around the impoundment. The groundwater level data will be collected in conjunction with the surface water monitoring. Groundwater and surface water elevation data will be collected at paired locations such as RT-5 and the south diversion ditch, at RT-7, and at Silver Creek. The data will be used to quantify the surface water-groundwater interaction. The hydrogeologic data coupled with existing and new groundwater chemistry will be used to evaluate the potential for groundwater impacts at the Site.

Shallow groundwater in the Silver Creek floodplain both above and below the tailings impoundment will be sampled and evaluated to determine the impact, if any, of the tailings from the Site on off-site shallow groundwater or surface water. A monitoring well will be installed downgradient of the Site in the Silver Creek alluvium. RT-7 will be used as the upgradient Silver Creek alluvial well. The data, along with all existing water quality data, will be used to better define and model groundwater quality in the Silver Creek alluvium.

As previously discussed in Section 5.2, Respondents will install three borings into the tailings areas located south of the diversion ditch to evaluate the potential for these tailings to impact groundwater or surface water in the south diversion ditch. The borings will be drilled down through the tailings and terminate at the tailings/soil interface.

The borings will be converted to monitoring wells if groundwater is encountered. Figure 3.3 shows the locations of the proposed borings.

Respondents will also evaluate the potential impacts to current users of groundwater near the Site. Respondents will conduct a survey of private wells within a one-mile radius of the Site. Respondents will locate and map groundwater elevations of all private wells within a one-mile radius of the Site. If the groundwater elevation data demonstrate that the wells are downgradient and connected to Site aquifers, then the wells will be sampled according to procedures outlined in the SAP and tested to assess whether potential groundwater impacts are occurring as a result of Site conditions.

Finally, groundwater monitoring well RT-1 will be abandoned because it was completed both in the shallow confined and unconfined aquifers. Based on the well construction, cross flow between the two aquifers may be occurring. According to state well construction regulations, such construction is not allowed without prior approval. Respondents will prepare a closure plan for the EPA RT-1 monitoring well, proposing that the well be grouted with a bentonite seal to within five feet of the ground surface and that the casing removed to below grade.

5.6 Main Embankment Investigation

The main embankment is the permanent enclosure device for the tailings materials. The stability and integrity of the main embankment have been examined two separate times by consultants for Noranda (Dames & Moore 1980) and EPA (E&E 1992). Although both groups determined that while the main embankment appeared to be stable in its then-current condition, concerns were raised about two issues:

- The oversteepened downstream slope of the embankment.
- Seepage present at the toe of the main embankment.

Respondents agree that portions of the main embankment are oversteepened and were not constructed in accordance with the recommendations made by Dames & Moore in 1974. As a result, Respondents proposes to design an appropriate wedge buttress to be installed along oversteepened portions of the main embankment. The buttress will

enhance the long-term effectiveness of the final closure remedy for the Site. Respondents will evaluate the condition of the main embankment during the RI/FS phase, and will prepare construction design specifications for the wedge buttress as part of the final remedial design process.

Because several of the groundwater monitoring wells installed by previous operators are currently located in the area where the wedge buttress would likely be constructed, United Park anticipates that it will be necessary to close these wells. United Park will prepare a well abandonment plan for EPA approval. The wells will be grouted with a bentonite seal to within five feet of the ground surface and the casing removed to below grade. Data from the seep may also need to be gathered in order to develop an appropriate wedge buttress design.

In addition, the long-term chemical stability of the tailings will be evaluated. Samples of the tailings materials will be collected at three (3) locations on the impoundment as shown on Figure 5.0. The samples will be analyzed for metals and long term leaching potential. The SAP provides details on the sample collection and analytical procedures.

5.7 Sampling and Analysis and Health and Safety Plans

As part of the focused RI/FS, Respondents will prepare a sampling and analysis plan (“SAP”), and a site health and safety plan (“HASP”). The SAP provides a mechanism for planning field activities and consists of a field sampling plan (FSP) and a quality assurance project plan (QAPP). The FSP will define the sampling and data-gathering methods that will be used on the project. The QAPP will describe the project objectives and organization, functional activities, and quality assurance and quality control (QA/QC) protocols that will be used to achieve the desired data quality objectives. The HASP will be prepared in conformance with the United Park's health and safety program, and in compliance with OSHA regulations and protocols.

6.0 FOCUSED RISK ASSESSMENT

The EPA will perform the focused risk assessment. Given the current isolated nature of the Site, the knowledge of future land use of the Site, and the past health assessments which have been conducted for the Site, EPA agrees that a "streamlined" risk assessment using a proposed future land use and a "focused" RI/FS (using existing data to the fullest extent possible and evaluating a limited number of alternatives consistent with proposed future land use) is appropriate.

7.0 TREATABILITY STUDIES

Respondents will develop and evaluate potential additional remedial alternatives to support a final closure of the Site that will be protective of human health and the environment, and consistent with the contemplated future land use of the Site. At this time, such additional remedial measures would not involve treatment of hazardous wastes or substances. Consequently, it is unlikely that treatability studies would need to be performed as part of the evaluation and selection of final additional remedial measures to support final closure of the Site. However, if new information comes to light as a result of Respondents' focused RI/FS efforts, or if circumstances change, then Respondents will evaluate the need for and conduct, as necessary, treatability tests in accordance with the NCP and EPA's Model the Statement of Work, and as approved by EPA.

8.0 FURTHER REMEDIAL ACTION

Based on the data collected from and the remedial measures that have already been implemented at the Site to date, and in consideration of remedial measures implemented at similar tailings impoundment sites throughout Utah and other Rocky Mountain states, Respondents believe that final Site closure can be achieved without the implementation of further remedial measures. However, Respondents recognize that EPA and UDEQ have concerns about Site conditions that the agencies believe must be

addressed through additional Site characterization and possibly through the implementation of additional remedial measures. Therefore, Respondents agree to further investigate the nature and extent of contamination at the Site to supplement the investigation efforts performed at the Site to date and confirm that the measures implemented at the Site to date are adequate to support final closure of the Site. If necessary, based on the findings of these efforts, Respondents will also develop and evaluate potential additional remedial alternatives to support a final closure of the Site that is protective of human health and the environment, and consistent with contemplated future land use of the Site. Respondents propose to use the data derived from the Focused RI/FS (together with a focused risk assessment to be performed by EPA) to determine whether any further remedial measures are needed to support final Site closure.

If and to the extent further remedial measures are required at all, Respondents believe that any appropriate final remedy for the Site should incorporate, to the maximum extent practicable, all existing elements of Site closure, and where necessary and appropriate, should adopt additional measures to improve Site closure. Such additional measures, if required, may include:

- Improving and maintaining the main embankment stability and integrity
- Improving and maintaining the soil cover
- Improving and maintaining the surface drainage
- Improving and maintaining the diversion ditches
- Excavating tailings located outside of the impoundment, placing the same within the impoundment, and placement of additional cover
- Establishing appropriate institutional controls to prevent unacceptable exposure risks

If necessary, as part of the FS, Respondents will develop appropriate remedial action objectives, and develop and evaluate potential additional remedial

alternatives, to support a final closure of the Site that is protective of human health and the environment. Respondents will begin to develop and evaluate a range of appropriate further remedial alternatives to support final Site closure, concurrent with the RI Site characterization task. Based on EPA's focused risk assessment, Respondents will review, and if necessary and appropriate for the Site: 1) modify the site-specific remedial action objectives; 2) develop general response actions for each medium of interest to satisfy the remedial action objectives; 3) identify areas or volumes of media to which general response actions may apply, taking into account requirements for protectiveness as identified in the remedial action objectives; 4) identify, screen and document technologies, if any, applicable to each general response action to eliminate those that cannot be implemented at the Site; 5) assemble and document further alternative remedial measures; 6) refine the further alternative remedial measures, as necessary; and 7) conduct and document a screening evaluation of each further remedial alternative measure.

Respondents will also conduct a detailed analysis of additional remedial alternatives to support final closure of the Site. These will consist of an analysis against a set of nine evaluation criteria to ensure that the selected additional remedial measures will be protective of human health and the environment; will be in compliance with, or include a waiver of, ARARs; will be cost-effective; will utilize permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable; and will address the statutory preference for treatment as a principal element (if appropriate). The evaluation criteria include: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state (or support agency) acceptance; and (9) community acceptance. (Note: criteria 8 and 9 are considered after the focused RI/FS report has been released to the general public.) As part of its evaluation of the long-term effectiveness of the final closure remedy for the Site, Respondents will also utilize, as appropriate, modeling

techniques to evaluate the long-term chemical stability of the materials within the tailings impoundment.

It should be noted that long-term, non-residential land uses are being considered for the Site and the Property. While the Property outside the impoundment is already suitable for development, the Property is not currently being used for any productive purpose. The area outside of the actual impoundment may be suitable for development for non-residential, recreational uses. Certain non-residential uses, consistent with the soil cover and any appropriate institutional controls, may be appropriate for the southern area of the tailings impoundment area itself.

9.0 DELIVERABLES

Respondents will prepare an RI/FS Report that will present analytical data collected during the focused remedial investigation and an interpretation of the data in relation to human health and environmental exposures. It will address the following topics:

- Site characteristics
- Site physical characteristics
- Source characteristics
- Nature and extent of contamination
- Contaminant fate and transport
- Streamlined risk evaluation

Respondents will also prepare an appropriate FSP, QAPP and HASP prior to fully implementing the work proposed in this Work Plan.

10.0 SCHEDULE

Respondents will develop a schedule to guide the work proposed in this document using the Critical Path Method (CPM). Negotiations with the EPA over the administrative agreement will determine the initiation date for the focused RI/FS and will define roles and responsibilities for its completion. Should additional work be deemed necessary as a result of the discovery of new information gathered in the performance of the work tasks outlined herein, the deliverable schedule will be adjusted to accommodate work revisions.

11.0 COMMUNITY RELATIONS

Consistent with the requirements of the NCP, EPA and UDEQ, with support from Respondents, will prepare a Community Relations Plan.

FIGURES

Figure 1.0: Site Location Map

Figure 2.0: Site Map

Figure 2.1: Site Geology

Figure 3.1: Sample Locations

Figure 3.2: Water Quality Data-Zinc (Surface)

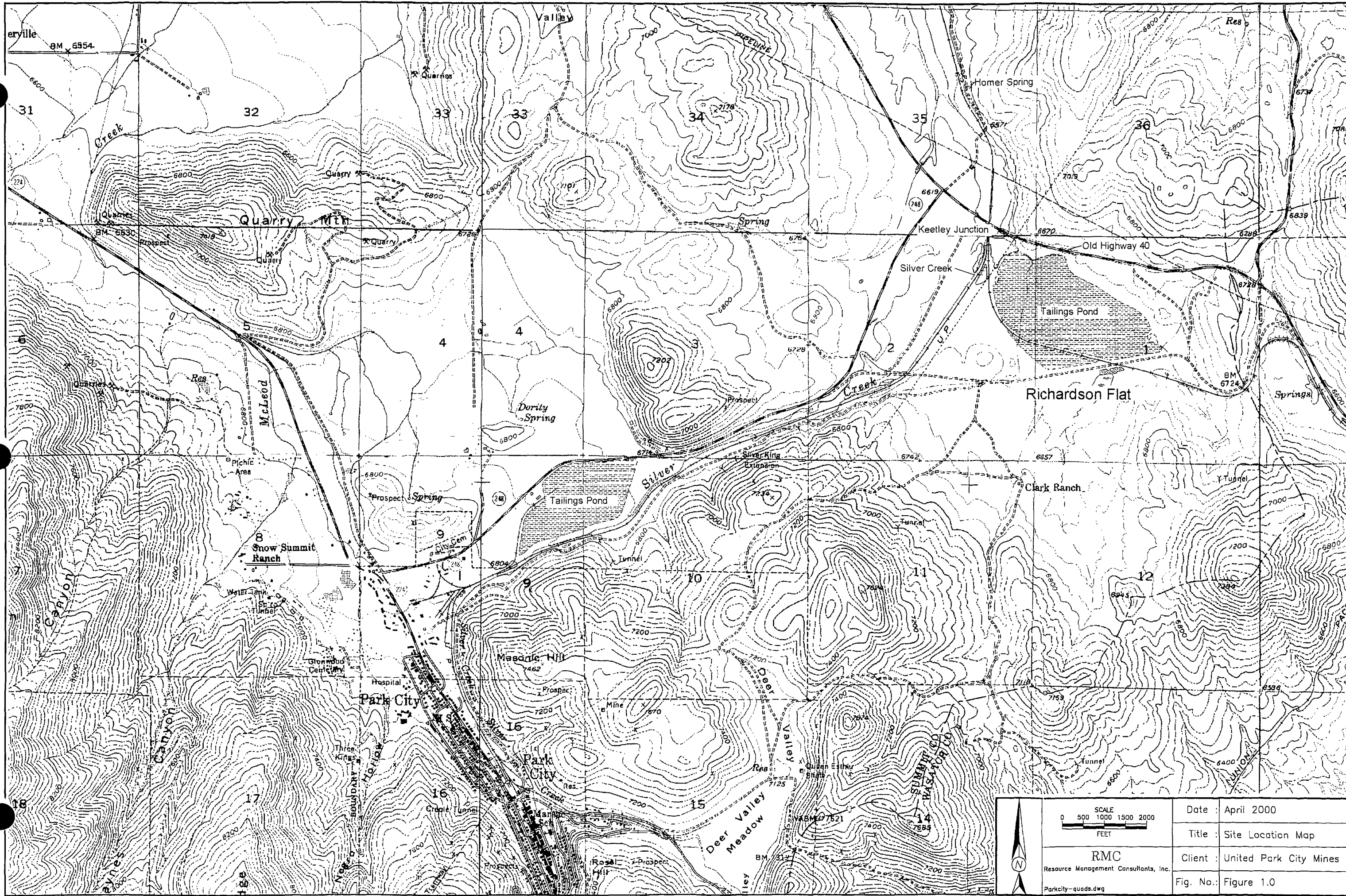
Figure 3.2a Water Quality Data-Zinc (Surface) Line Graph


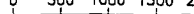
Figure 3.3: Sample Locations

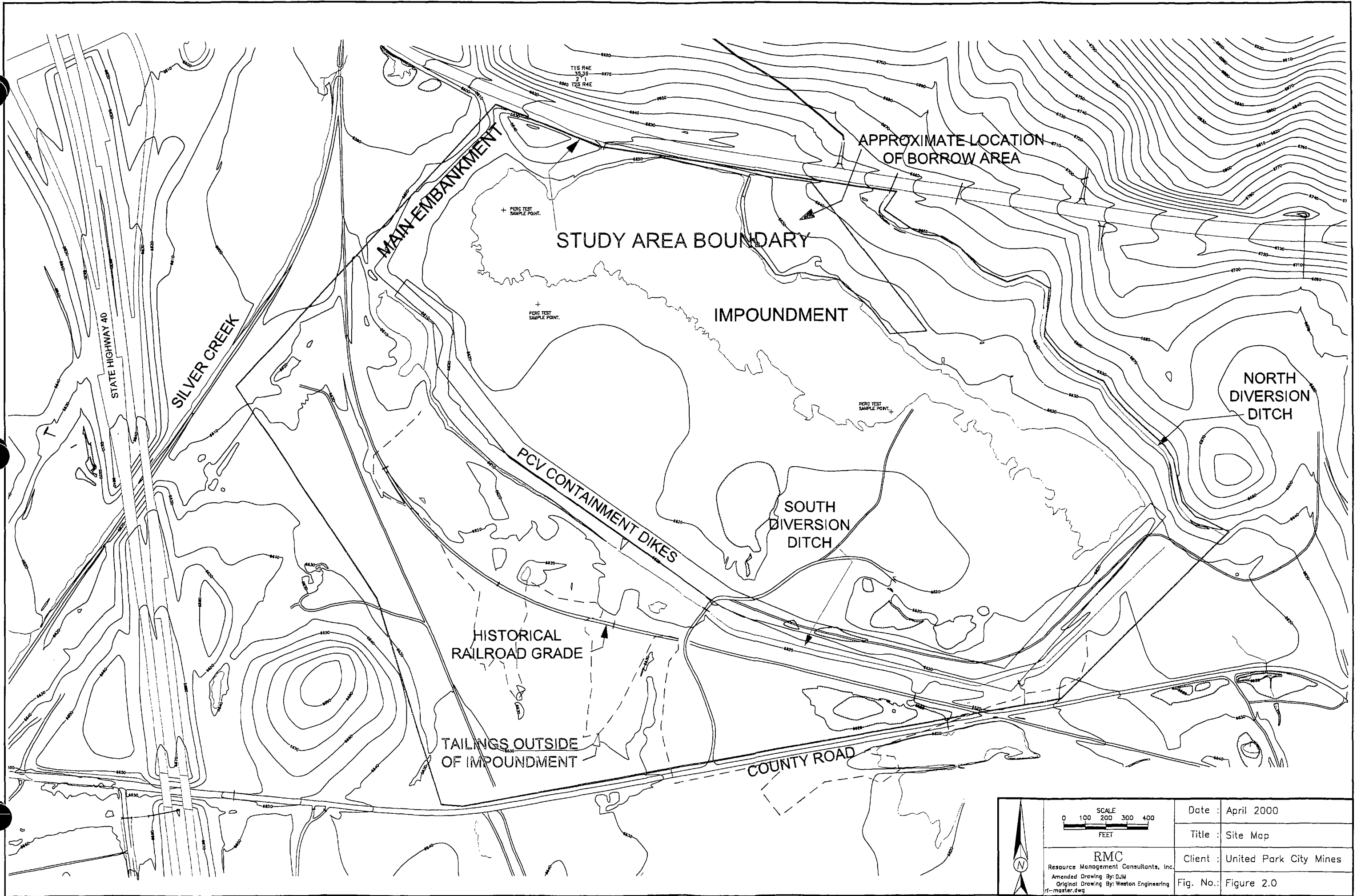
Figure 4.0: Preliminary Site Model


Figure 5.0: Soil Sediment and Tailings Sample Locations

Figure 6.0: Off-Site Soil Sample Locations



	<div>SCALE</div> <div>0 500 1000 1500 2000</div> <div></div> <div>FEET</div>	Date : April 2000
	<div>RMC</div> <div>Resource Management Consultants, Inc.</div>	Title : Site Location Map
	<div>Parkcity-quads.dwg</div>	Client : United Park City Mines
		Fig. No.: Figure 1.0



	SCALE 0 100 200 300 400 FEET	Date : April 2000
	RMC Resource Management Consultants, Inc. Amended Drawing By: DJM Original Drawing By: Weston Engineering rf-master.dwg	Title : Site Map
		Client : United Park City Mines
		Fig. No.: Figure 2.0

PARK CITY
KEETLEY WELL

KEETLEY
VOLCANICS

KEETLEY JUNCTION

TAILINGS
POND

RICHARDSON FLAT

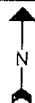
ALLUVIUM

CLARK RANGE

WEBER
QUARTZITE

DRAFT

* Figure as amended from
Bromfield and Crillendon, 1971



RMC
Resource Management
Consultants, Inc.

Date :	June 21, 1999
Title :	RF Geology
Client :	United Park City Mines
Fig. No. :	FIGURE 2.1

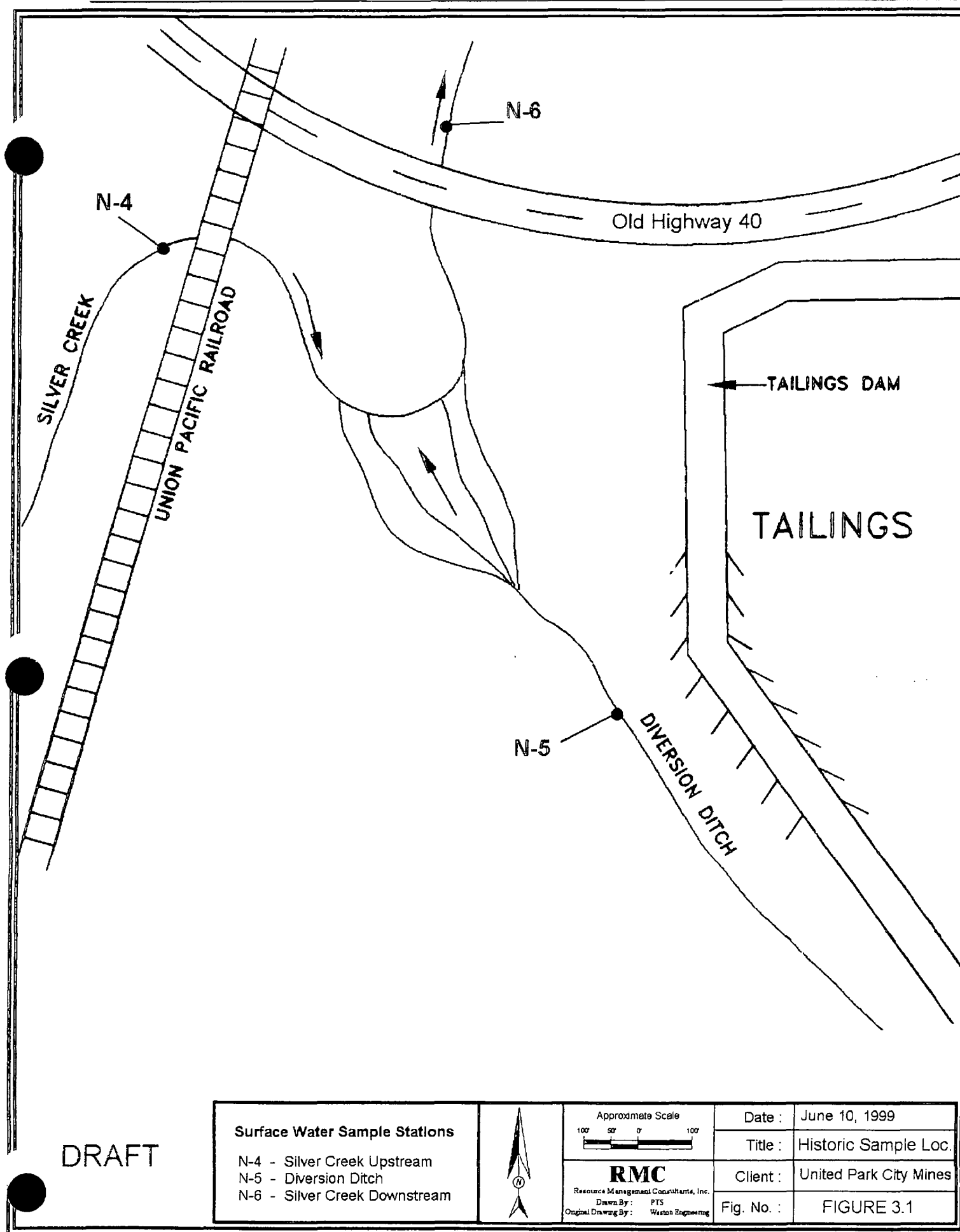


FIGURE 3.2
Richardson Flat Surface Water
Zinc (T) ppm

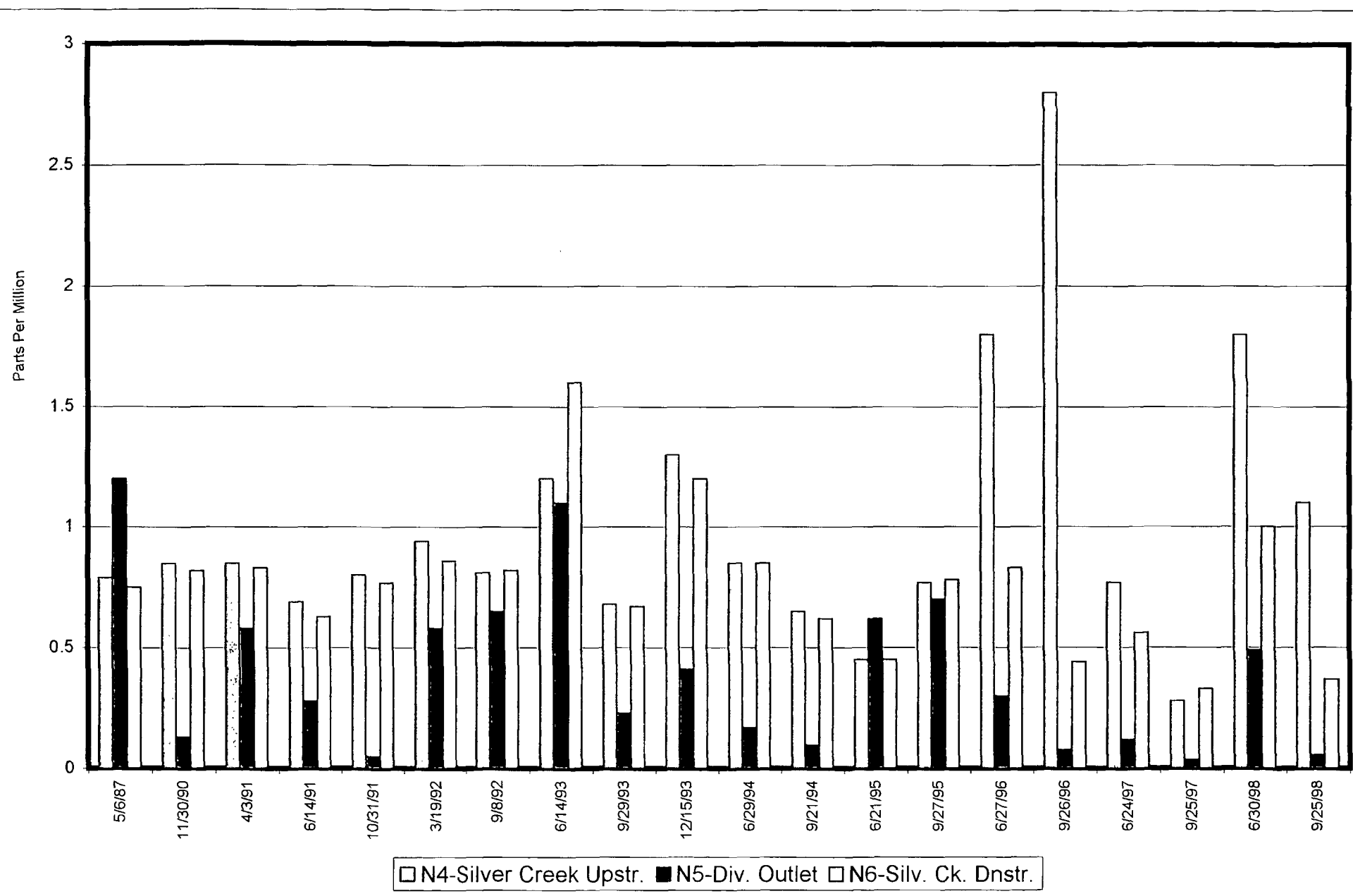
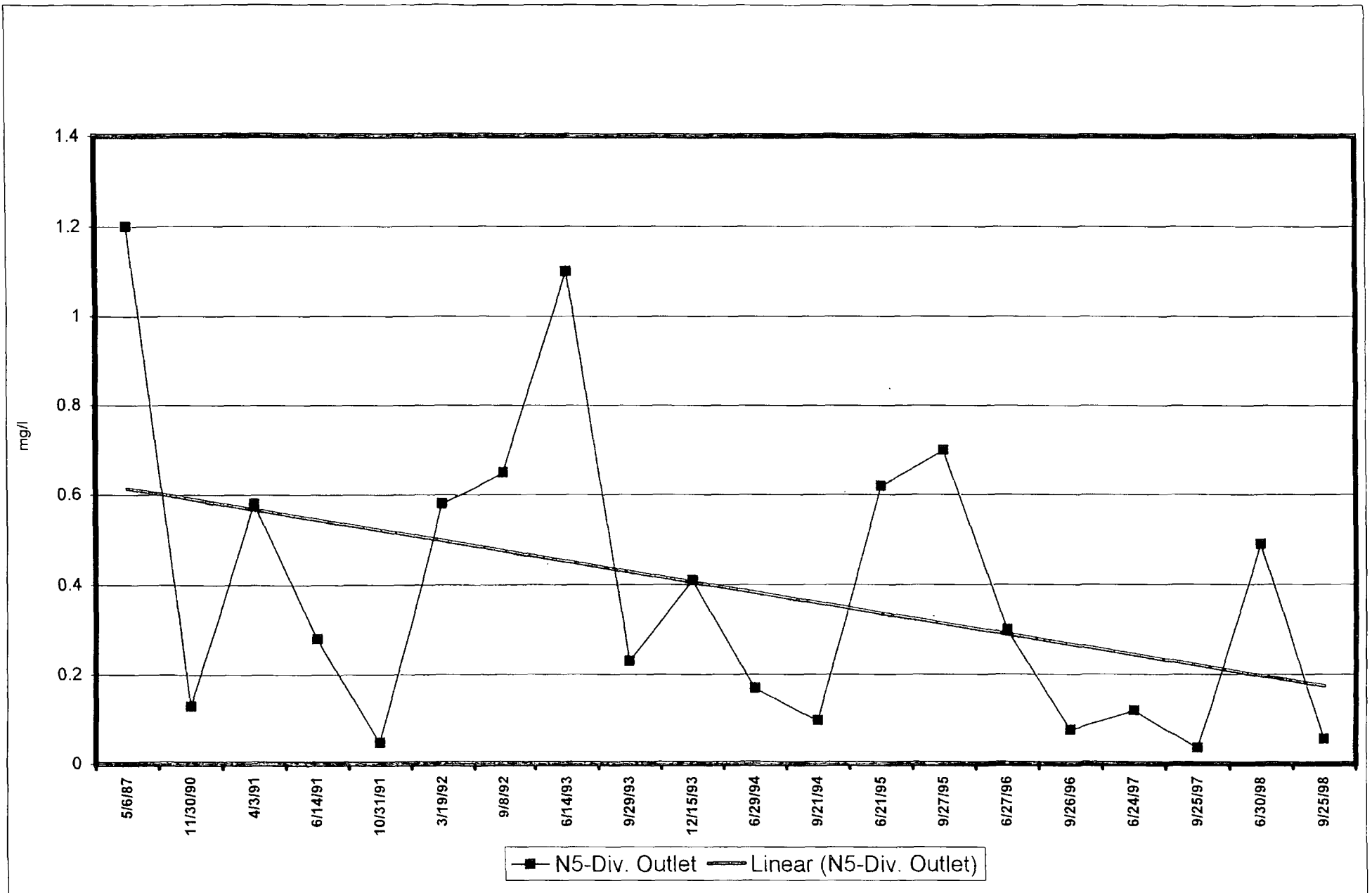
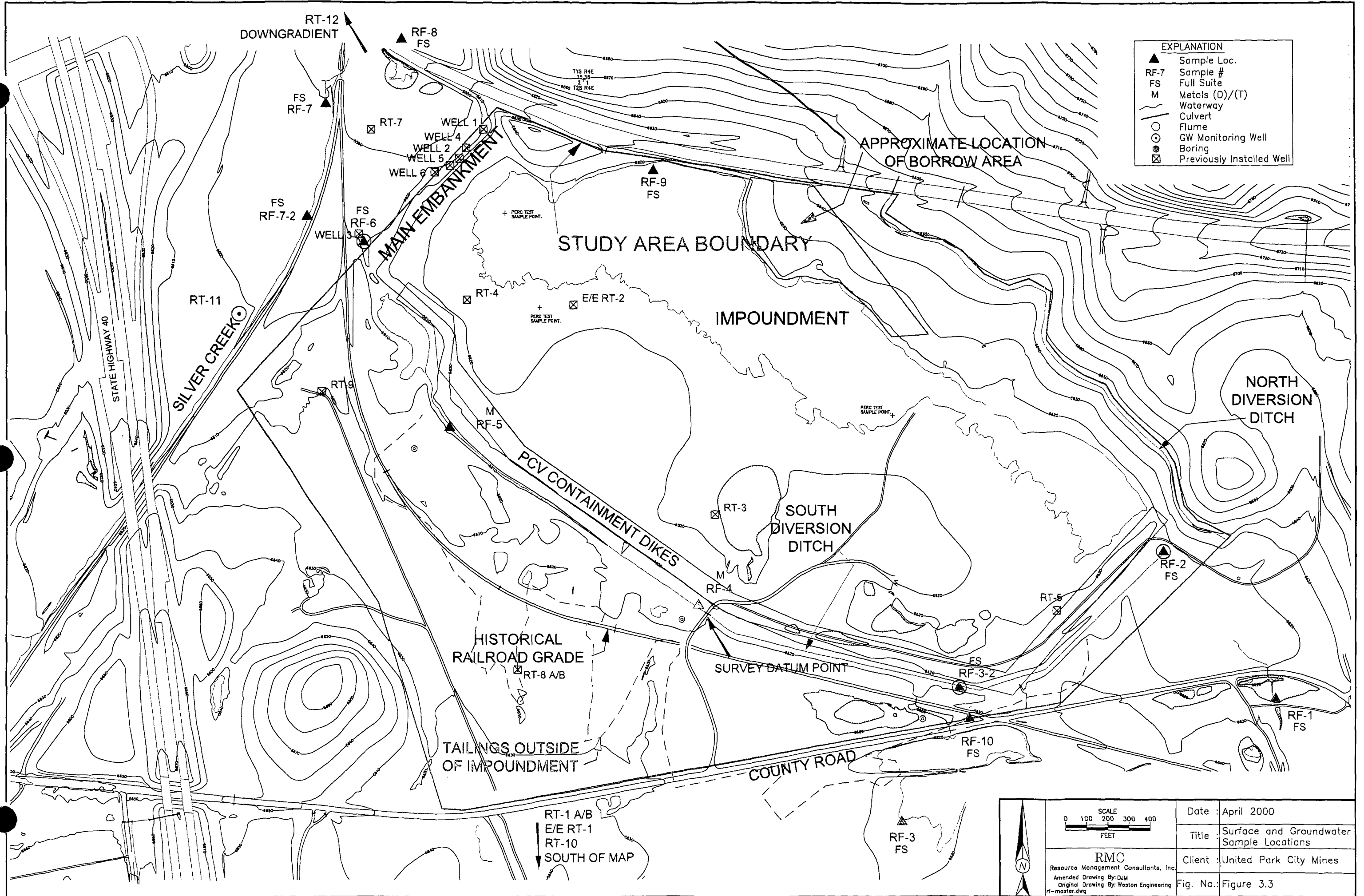



FIGURE 2a

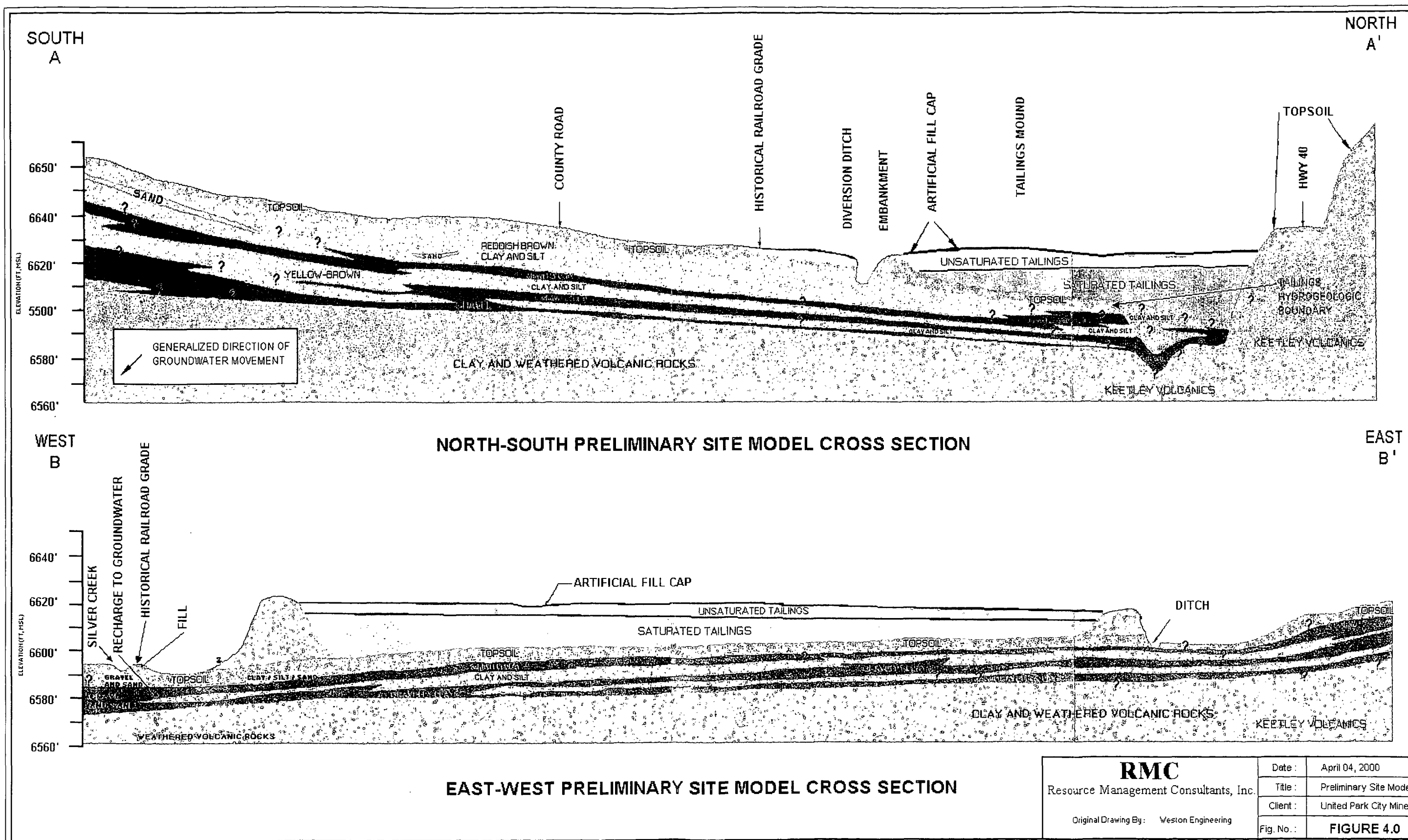
Richardson Flat Surface Water - Diversion Ditch Outlet - Station N5
Zinc (T) mg/l



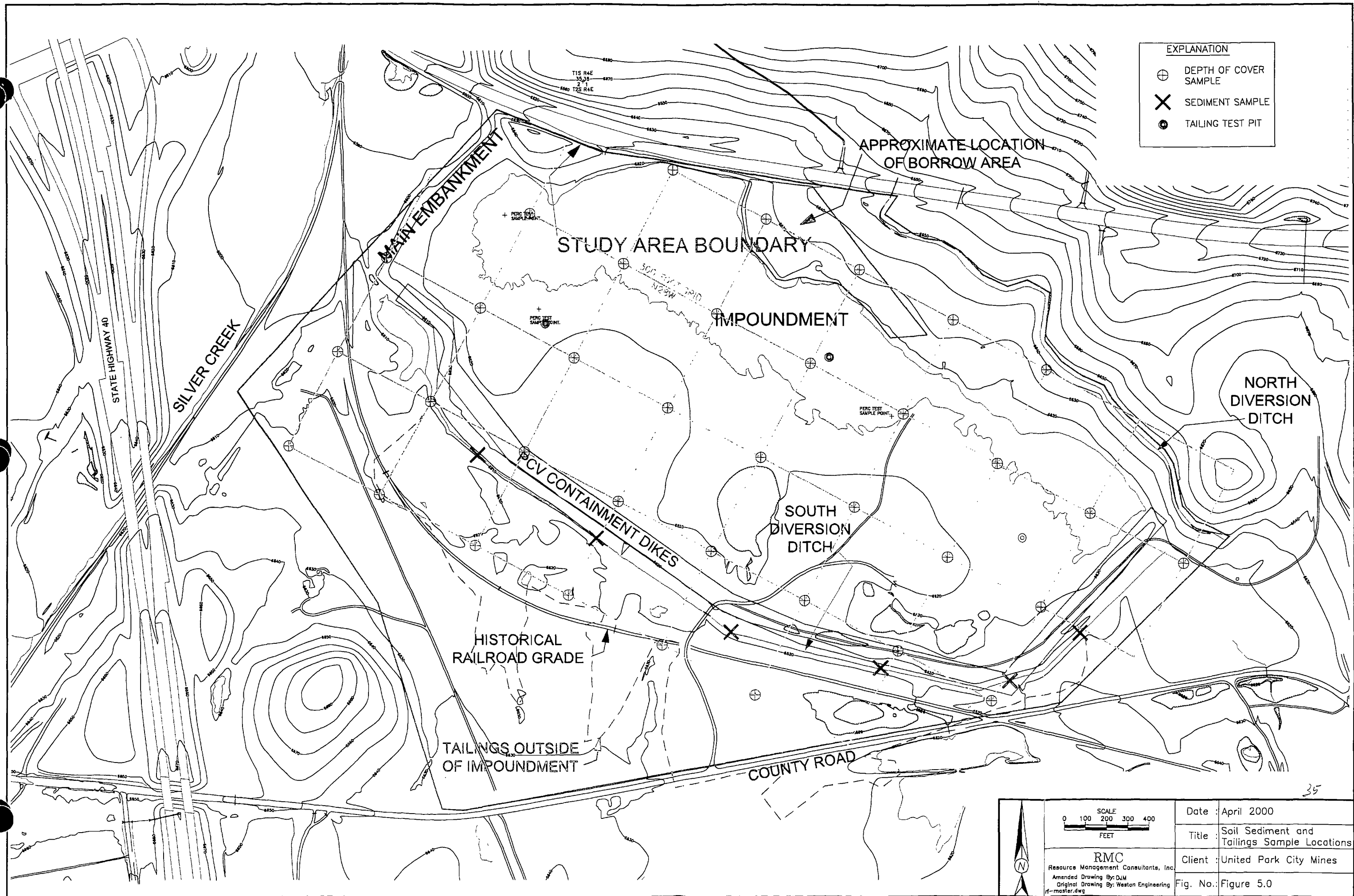


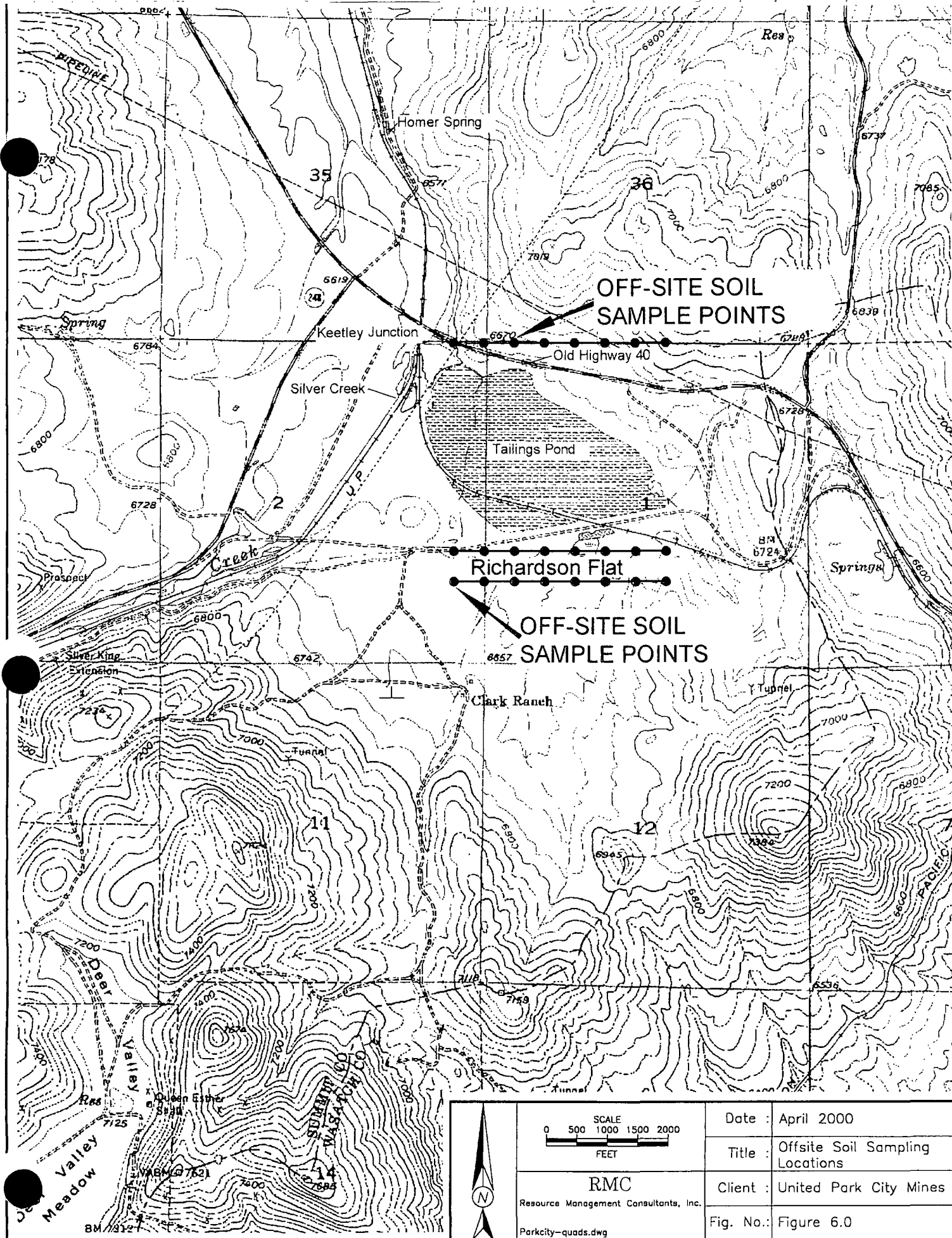
EXPLANATION	
▲	Sample Loc.
RF-7	Sample #
FS	Full Suite
M	Metals (D)/(T)
—	Waterway
—	Culvert
○	Flume
⊙	GW Monitoring Well
⊗	Boring
⊠	Previously Installed Well

 RMC Resource Management Consultants, Inc. Amended Drawing By: DJM Original Drawing By: Weston Engineering rt-master.dwg	SCALE 0 100 200 300 400 FEET	Date : April 2000
		Title : Surface and Groundwater Sample Locations
		Client : United Park City Mines
		Fig. No.: Figure 3.3



RMC Resource Management Consultants, Inc. Original Drawing By: Weston Engineering	Date:	April 04, 2000
	Title:	Preliminary Site Model
	Client:	United Park City Mines
	Fig. No.:	FIGURE 4.0





TABLES

Table 3.1: Historic Surface Water Data

Table 3.2: Historic Groundwater Data

Table 3.3 Comparison of 1985, 1992 and 1998 Groundwater Data

Table 3.4: 1999 Surface Water Data

Table 5.2: Analytical List

Table 3.1: Richardson Flats Surface Water Results,
1982 to 1987 and 1990 to 1998
All units are in mg/l.

Station N4 - Upstream Silver Creek

Date	25-Sep-98	30-Jun-98	25-Sep-97	24-Jun-97	26-Sep-96	27-Jun-96	27-Sep-95	21-Jun-95	21-Sep-94	29-Jun-94	15-Dec-93	29-Sep-93	14-Jun-93	8-Sep-92	19-Mar-92	31-Oct-91	14-Jun-91	3-Apr-91	30-Nov-90	9-Sep-87	3-Aug-87	7-Jul-87	5-Jun-87	6-May-87	5-Nov-86	10-Oct-86	3-Sep-86	10-Aug-86	1-Aug-86	1-Jul-86	5-Jun-86	
Cu	0.043	0.27	0.012	<0.008	0.39	0.038	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0005	<0.0005	<0.0005	-	-	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	
Hg	<0.0002	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0005	<0.0005	<0.0005	-	-	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	
Mn-T	0.34	0.58	0.8	1.3	0.5	0.79	0.24	0.18	0.14	0.28	0.24	0.3	0.28	0.55	0.25	0.073	0.16	0.2	0.18	0.33	0.033	0.12	0.16	-	0.36	0.17	0.027	-	0.085	0.038	0.1	
Pb-T	1.6	7.5	0.035	0.038	26	2.6	<0.01	0.012	0.033	0.02	0.033	0.033	<0.02	0.15	0.37	0.033	0.079	0.05	<0.02	0.18	0.033	0.02	0.05	0.12	0.05	0.05	0.05	-	0.033	0.02	0.07	
Pb-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-	-	-	-	
Zn-T	1.1	1.8	0.28	0.77	2.8	2.8	0.77	0.45	0.65	0.85	1.3	0.68	1.2	0.81	0.94	0.8	0.69	0.85	0.85	-	-	-	-	0.79	-	-	-	-	-	-	-	
Zn-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.56	-	-	-	-	-	-	-	
Cn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.004	<0.004	<0.004	<0.004	-	<0.004	0.004	<0.004	-	<0.004	0.007	<0.004	
TDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	730	666	628	720	-	1053	638	642	-	615	604	280
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.8	-	-	-	-	-	-	-	

Date	1-May-86	7-Apr-86	4-Nov-85	3-Oct-85	9-Sep-85	2-Aug-85	10-Jul-85	3-Jun-85	1-May-85	1-Nov-84	3-Oct-84	6-Sep-84	10-Aug-84	3-Jul-84	8-Jun-84	1-Nov-83	6-Oct-83	2-Sep-83	2-Aug-83	6-Jul-83	8-Jun-83	31-Jan-83	3-Jan-83	3-Dec-82	1-Nov-82	1-Oct-82	30-Aug-82	2-Aug-82	1-Jul-82	1-Jun-82	29-Apr-82
Cu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hg	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	2	<0.0005	<0.0005	0.9	<0.0005	0.0089	<0.0005	<0.0005	<0.0005	0.0046	<0.0005	0.0008	<0.0005	<0.0005	0.0008	<0.0005	<0.0005	<0.0005	<0.0005	0.0007
Mn-T	0.18	0.27	0.33	0.17	0.1	0.055	0.33	0.083	0.3	0.083	0.1	0.055	0.4	0.7	0.37	0.13	0.67	0.33	0.1	0.28	0.38	0.38	0.33	0.32	0.17	0.38	0.12	0.17	0.17	0.43	0.28
Pb-T	0.03	0.083	0.05	0.12	0.05	0.033	0.05	0.05	0.18	0.067	0.067	0.78	0.067	0.1	0.13	0.05	1.3	0.033	0.05	0.05	0.9	0.38	0.17	0.07	0.38	0.12	0.17	0.17	0.17	0.43	0.28
Pb-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn-T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cn	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.054	<0.008	<0.004	0.014	<0.004	0.004	0.009	<0.004	<0.004	<0.004	<0.004	0.005	<0.004	<0.004	0.004	<0.004
TDS	648	760	638	583	729	558	648	498	661	552	600	456	1015	684	387	813	586	830	726	496	303	720	659	809	609	538	719	723	554	516	491
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Station N5 - Diversion Ditch

Date	25-Sep-98	30-Jun-98	25-Sep-97	24-Jun-97	26-Sep-96	27-Jun-96	27-Sep-95	21-Jun-95	21-Sep-94	29-Jun-94	15-Dec-93	29-Sep-93	14-Jun-93	8-Sep-92	19-Mar-92	31-Oct-91	14-Jun-91	3-Apr-91	30-Nov-90	9-Sep-87	3-Aug-87	7-Jul-87	5-Jun-87	6-May-87	5-Nov-86	10-Oct-86	3-Sep-86	10-Aug-86	1-Aug-86	1-Jul-86	5-Jun-86
Cu	<0.008	<0.008	0.013	<0.008	0.008	<0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Hg	<0.0002	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mn-T	3.4	1.7	1.9	7	7.7	2.1	1.1	1.4	8.7	1.8	8.3	1.7	1.5	61	1.2	0.083	0.42	0.92	3	3.1	1.3	1.6	1.4	-	1.1	0.78	1.8	0.75	0.045	1.2	0.23
Pb-T	<0.01	<0.01	<0.01	<0.01	0.014	<0.01	<0.01	<0.01	0.05	0.033	0.05	0.05	<0.02	<0.1	<0.02	0.033	0.095	0.02	<0.02	0.067	0.02	0.05	0.067	<0.017	0.033	0.067	0.05	0.05	0.05	0.02	<0.017
Pb-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.017	-	-	-	-	-	-	-
Zn-T	0.056	0.49	0.036	0.12	0.076	0.3	0.7	0.62	0.097	0.17	0.41	0.23	1.1	0.65	0.58	0.048	0.28	0.58	0.13	-	-	-	-	1.2	-	-	-	-	-	-	-
Zn-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.76	-	-	-	-	-	-	-
Cn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.004	<0.004	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
TDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1867	1704	1511	1300	-	1676	1538	1671	1882	1731	1693	1542
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	-	-	-	-	-	-

Date	1-May-86	7-Apr-86	4-Nov-85	3-Oct-85	9-Sep-85	2-Aug-85	10-Jul-85	3-Jun-85	1-May-85	1-Nov-84	3-Oct-84	6-Sep-84	10-Aug-84	3-Jul-84	8-Jun-84	1-Nov-83	6-Oct-83	2-Sep-83	2-Aug-83	6-Jul-83	8-Jun-83	31-Jan-83	3-Jan-83	3-Dec-82	1-Nov-82	1-Oct-82	30-Aug-82	2-Aug-82	1-Jul-82	1-Jun-82	29-Apr-82
Cu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mn-T	0.84	0.58	0.7	1.2	0.6	1.4	1.6	1.7	2	0.95	0.1	0.57	-	0.23	0.48	0.17	0.17	0.48	0.22	0.53	1.4	-	3.2	0.45	9.5	1.4	6	6.1	3	3.1	0.33
Pb-T	0.02	0.033	0.042	0.067	0.067	0.042	0.02	0.05	0.1	0.05	0.067	0.067	-	0.053	0.033	0.05	0.05	0.05	0.05	0.067	0.05	-	0.07	0.35	0.03	0.05	0.08	0.07	0.08	0.08	0.08
Pb-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn-T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cn	<0.004	<0.004	<0.004	<0.004	<0.004	0.004	<0.004	<0.004	0.014	<0.004	<0.004	<0.004	-	0.004	<0.004	0.007	0.016	<0.004	0.006	<0.004	<0.004	-	<0.004	0.004	<0.004	<0.004	0.007	0.006	0.019	0.034	<0.004
TDS	687	566	1277	1570	1610	1372	1520	1418	870	1168	581	1717	-	1533	655	1419	1809	1867	1762	1604	1010	-	1343	839	1192	881	1979	2016	1640	1517	638
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Station N6 - Downstream Silver Creek

Date	25-Sep-98	30-Jun-98	25-Sep-97	24-Jun-97	26-Sep-96	27-Jun-96	27-Sep-95	21-Jun-95	21-Sep-94	29-Jun-94	15-Dec-93	29-Sep-93	14-Jun-93	8-Sep-92	19-Mar-92	31-Oct-91	14-Jun-91	3-Apr-91	30-Nov-90	9-Sep-87	3-Aug-87	7-Jul-87	5-Jun-87	6-May-87	5-Nov-86	10-Oct-86	3-Sep-86	10-Aug-86	1-Aug-86	1-Jul-86	5-Jun-86
Cu	<0.008	<0.008	0.009	<0.008	0.011	<0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005
Hg	<0.0002	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005
Mn-T	0.3	0.45	0.2	0.7	0.35	0.36	0.26	0.21	0.16	0.4	0.21	0.25	0.43	0.56	0.21	0.057	0.12	0.22	0.18	0.32	0.11	0.19	0.24	-	0.3	0.23	0.37	-	0.93	0.057	0.11
Pb-T	<0.01	0.05	<0.01	0.033	0.042	0.016	<0.01	0.01	0.033	0.033	0.033	0.05	0.025	0.22	0.043	0.033	0.097	0.08	<0.02	0.13	0.058	0.12	0.12	0.14	0.27	0.083	0.05	-	0.05	0.02	0.04
Pb-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.025	-	-	-	-	-	-	-
Zn-T	0.37	1	0.33	0.56	0.44	0.83	0.78	0.45	0.82	0.85	1.2	0.67	1.6	0.82	0.86	0.77	0.83	0.83	0.82	-	-	-	-	0.75	-	-	-	-	-	-	-
Zn-D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.37	-	-	-	-	-	-	-
Cd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.004	<0.005	<0.004	<0.004	-	0.005	<0.004	<0.004	-	<0.004	<0.004	<0.004
TDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	723	655	915	750	-	888	636	629	-	656	569	285
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.7	-	-	-	-	-	-	-

Table 3.2: Richarson Flat Groundwater Results, 1982 to 1987 and 1991 to 1998

All units are in mg/l except pH (standard units).

Station MW-1	Date	25-Sep-98	30-Jun-98	25-Sep-97	24-Jun-97	26-Sep-96	27-Jun-96	27-Sep-95	21-Jun-95	21-Sep-94	29-Jun-94	15-Dec-93	29-Sep-93	14-Jun-93	8-Sep-92	19-Mar-92	31-Oct-91	14-Jun-91	3-Apr-91	9-Sep-87	3-Aug-87	7-Jul-87	5-Jun-87	6-May-87	2-Dec-86	5-Nov-86	10-Oct-86	3-Sep-86	1-Aug-86	1-Jul-86	5-Jun-86	
	Cu	<0.008	<0.008	0.012	<0.008	0.011	<0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
	Hg	<0.0002	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
	Mn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.067	0.11	0.052	0.47	0.25	0.27	0.14	0.05	0.017	0.082	0.16	0.11
	Mn-D	10	8.9	9.1	9.4	8.7	0.65	0.6	0.71	0.65	0.56	0.48	1.1	0.63	33	0.18	0.062	<0.02	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.067	0.035	0.033	0.083	0.08	0.083	0.033	0.05	0.05	0.04	0.05	0.017
	Pb-D, TR	<0.01	<0.01	<0.01	<0.01	<0.01	0.016**	<0.01	<0.01	0.033**	0.033**	0.033**	0.033**	<0.02	<0.1	<0.02	0.02	0.57	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zn-D	0.038	0.049	0.025	0.12	0.19	0.016	0.027	0.049	0.023	0.01	0.042	0.11	0.041	<0.050	0.25	0.018	0.039	0.017	-	-	-	-	-	-	-	-	-	-	-	-	-
	pH	7.2	7.4	6.9	6.9	6.6	7	8	7.3	7.3	7.8	7.1	7.1	6.9	7.7	7.8	7.8	7.6	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-
	TDS	730	1575	2044	1836	1919	1212	1124	1101	1093	1083	1082	1068	596	1732	901	826	750	842	841	919	843	1100	1041	1143	1433	1163	1216	1182	1169	1171	
	Cn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.004	<0.004	<0.004	0.006	<0.004	<0.004	<0.004	0.008	<0.004	<0.004	0.013	<0.004

Station MW-3	Date	25-Sep-98	30-Jun-98	25-Sep-97	24-Jun-97	26-Sep-96	27-Jun-96	27-Sep-95	21-Jun-95	21-Sep-94	29-Jun-94	15-Dec-93	29-Sep-93	14-Jun-93	8-Sep-92	19-Mar-92	31-Oct-91	14-Jun-91	3-Apr-91	9-Sep-87	3-Aug-87	7-Jul-87	5-Jun-87	6-May-87	2-Dec-86	5-Nov-86	10-Oct-86	3-Sep-86	1-Aug-86	1-Jul-86	5-Jun-86	
	Cu	<0.008	<0.008	0.012	<0.008	0.008	<0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
	Hg	<0.0002	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
	Mn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	4.8	5.4	5	4.2	4.5	2.9	1.7	4	2.5	0.95	2.8
	Mn-D	0.85	0.76	0.75	0.78	0.72	7.7	6	4.6	6.6	4.7	7.3	6.4	5	-	3.8	3.7	2.2	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.02	0.083	0.1	0.053	0.067	0.033	0.067	0.033	0.05	0.033	0.03
	Pb-D, TR	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.025**	0.05**	0.05**	0.05**	0.033**	<0.02	-	0.02	0.02	0.062	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zn-D	0.034	0.034	0.035	0.03	0.017	0.017	0.033	0.037	0.054	0.023	0.047	0.11	0.033	-	0.17	0.047	0.065	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-
	pH	7.2	7.4	6.8	6.9	6.7	6.9	8	7.3	7.2	7.9	7.1	7.2	7.1	-	7.7	7.9	7.7	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-
	TDS	1736	1153	1335	1344	1145	1610	1588	1071	1775	1445	1629	1600	741	-	1479	1711	14321	1681	1639	1490	1374	1500	1458	1622	2046	1755	1539	1516	1438	1338	
	Cn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.004	<0.004	<0.004	0.005	0.005	0.004	<0.004	<0.004	<0.004	0.007	0.004	0.006

on MW-4	Date	25-Sep-98	30-Jun-98	25-Sep-97	24-Jun-97	26-Sep-96	27-Jun-96	27-Sep-95	21-Jun-95	21-Sep-94	29-Jun-94	15-Dec-93	29-Sep-93	14-Jun-93	8-Sep-92	19-Mar-92	31-Oct-91	14-Jun-91	3-Apr-91	9-Sep-87	3-Aug-87	7-Jul-87	5-Jun-87	6-May-87	2-Dec-86	5-Nov-86	10-Oct-86	3-Sep-86	1-Aug-86	1-Jul-86	5-Jun-86	
	Cu	0.009	<0.008	0.014	0.008	0.015	<0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hg	<0.0002	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
	Mn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.8	11	12	11	6.2	0.23	11	9.4	7.5	8.4	9.4	11
	Mn-D	7.2	2.2	6.9	2.1	2	3	4.1	5.7	4.3	3.1	3.6	4.8	7.7	-	7.4	4.7	11	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.067	0.035	0.05	0.083	0.017	0.05	0.067	0.083	0.067	0.087	0.17	0.017
	Pb-D, TR	<0.01	0.018**	0.018**	0.046**	0.033**	0.018**	<0.01	<0.01	0.05**	0.05**	0.033**	0.033**	<0.02	-	<0.02	<0.02	0.11	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zn-D	0.066	0.11	0.044	0.064	0.035	0.085	0.066	0.034	0.03	0.058	0.12	0.12	0.47	-	0.28	0.35	0.12	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
	pH	2.7**	7.4	7.3	6.7	6.6	7	7.3	6.4**	7.2	7.2	7	6.9	6.8	-	3.1**	7.8	5.6**	5**	-	-	-	-	-	-	-	-	-	-	-	-	-
	TDS	819	1783	2150	1848	1543	1879	2448	2591	1896	2260	2168	2175	2690	-	1911	2289	2190	2348	2583	2593	2556	2700	1902	689	2913	2531	2553	2563	1609	2559	
	Cn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																

All units are in mg/l. except pH (standard units).

Table 3.3: Comparison of 1985, 1992, and 1998 Groundwater Data
All units are in mg/l except pH (standard units).

Location: Well RT-1				
Date	September, 1985 ¹		August, 1992 ¹	
Sample ID	RF-GW-1		RF-GW-04	
	Total	Dissolved	Total	Dissolved
Aluminum	1.04	<0.03	15.7	0.191
Antimony	<0.005	<0.005	0.02436	0.0332
Arsenic	<0.005	<0.005	0.0037	0.0036
Barium	0.083	0.076	0.196	0.0939
Beryllium	<0.01	<0.01	0.0013	0.0009
Cadmium	<0.005	<0.005	0.0033	0.0033
Calcium	0.045	0.047	42.2	43.5
Chromium	<0.005	<0.005	0.0105	0.0078
Cobalt	<0.005	<0.005	0.011	0.006
Copper	<0.005	<0.005	0.03	0.171
Iron	0.955	<0.01	14.1	0.151
Lead	<0.03	<0.03	0.627	0.0409
Magnesium	0.909	0.908	12.2	0.0088
Manganese	0.02	0.011	0.162	0.0195
Mercury	<0.0001	<0.0001	0.0002	0.0002
Nickel	<0.03	<0.03	0.013	0.0111
pH	-	-	-	-
Potassium	-	-	1.39	1.36
Selenium	<0.005	<0.005	0.003	0.003
Silver	<0.005	<0.005	0.0024	0.01
Sodium	0.016	0.016	16.1	16.8
TDS	-	-	-	-
Thallium	<0.1	<0.1	0.0016	0.0016
Tin	-	-	-	-
Vanadium	<0.01	<0.01	0.0357	0.0357
Zinc	<0.005	0.006	0.136	0.0201
Cyanide	<0.01	-	-	-
Sulfate	0.035	-	-	-

Location: Well MW-1						
Date	September, 1985 ¹		August, 1992 ¹		September, 1998 ²	
Sample ID	RF-GW-3		RF-GW-05		MW-1	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	80.7	<0.03	2.69	0.0496	-	-
Antimony	<0.005	<0.005	0.0243	0.0405	-	-
Arsenic	0.076	<0.005	0.0052	0.0036	-	-
Barium	1.534	0.104	0.0996	0.064	-	-
Beryllium	-	<0.01	0.0034	0.0018	-	-
Cadmium	0.042	<0.005	0.0033	0.0033	-	-
Calcium	0.352	0.254	191	196	-	-
Chromium	0.095	<0.005	0.0078	0.0078	-	-
Cobalt	0.046	0.01	0.0075	0.006	-	-
Copper	1.583	<0.005	0.03	0.02	<0.008	-
Iron	126	0.376	3.18	0.0626	-	-
Lead	0.588	<0.03	0.0156	0.0022	-	<0.01
Magnesium	0.088	0.056	44.2	41.8	-	-
Manganese	2.23	0.924	0.89	0.684	-	10
Mercury	0.0007	<0.0001	0.0002	0.0002	<0.0002	-
Nickel	0.088	<0.03	0.0111	0.0249	-	-
pH	-	-	-	-	7.2	-
Potassium	-	-	6.06	5.53	-	-
Selenium	<0.005	<0.005	0.015	0.015	-	-
Silver	<0.005	<0.005	0.0024	0.01	-	-
Sodium	0.044	0.042	38.1	35.7	-	-
TDS	-	-	-	-	-	730
Thallium	<0.1	<0.1	0.0016	0.0016	-	-
Tin	-	-	-	-	-	-
Vanadium	0.262	<0.01	0.0357	0.0357	-	-
Zinc	0.65	<0.005	0.0995	0.0144	-	0.038
Cyanide	<0.1	-	-	-	-	-
Sulfate	0.625	-	-	-	-	-

Location: Well MW-6						
Date	September, 1985 ¹		August, 1992 ¹		September, 1998 ²	
Sample ID	RF-GW-2		RF-GW-09		MW-6	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	4.92	<0.03	1.63	0.0685	-	-
Antimony	0.063	<0.005	0.0284	0.0359	-	-
Arsenic	0.349	0.009	0.0113	0.0088	-	-
Barium	2.665	0.099	0.0583	0.0462	-	-
Beryllium	<0.01	<0.01	0.0049	0.0037	-	-
Cadmium	0.016	<0.005	0.0033	0.0033	-	-
Calcium	0.314	0.307	318	365	-	-
Chromium	0.042	<0.005	0.0078	0.0078	-	-
Cobalt	0.08	0.067	0.009	0.006	-	-
Copper	0.19	<0.005	0.02	0.02	<0.008	-
Iron	26.3	14.8	3.19	2.17	-	-
Lead	1.08	<0.03	0.031	0.0022	-	<0.01
Magnesium	0.072	0.07	52.5	55	-	-
Manganese	10.4	9.99	6.67	7.42	-	9.4
Mercury	0.0001	<0.0001	0.0002	0.0002	-	<0.0002
Nickel	0.03	<0.03	0.0256	0.0289	-	-
pH	-	-	-	-	7.1	-
Potassium	-	-	3.29	3.01	-	-
Selenium	<0.005	<0.005	0.015	0.015	-	-
Silver	0.017	<0.005	0.0033	0.01	-	-
Sodium	0.054	0.052	0.486	49.7	-	-
TDS	-	-	-	-	-	1354
Thallium	<0.1	<0.1	0.0016	0.0016	-	-
Tin	-	-	-	-	-	-
Vanadium	0.017	<0.01	0.0357	0.0357	-	-
Zinc	2.79	0.144	0.0925	0.0131	-	0.061
Cyanide	0.2	-	-	-	-	-
Sulfate	0.775	-	-	-	-	-

¹ Data collected by EPA contractor, E&E in 1984 and 1992

² Data collected by United Park

UTAH GROUND WATER QUALITY STANDARDS (units mg/l, standards for dissolved metals)

METALS		
Arsenic		0.05
Barium		2.0
Cadmium		0.005
Chromium		0.1
Copper		1.3
Lead		0.015
Mercury		0.002
Selenium		0.05
Silver		0.1
Zinc		5.0

Table 3.4: Richardson Flat Surface Water Sample Data, May 19, 1999 and June 9, 1999

Sample Results Compared to Aquatic Wildlife Criteria

Sample Location	Utah Water Quality Standards		Arsenic ⁽¹⁾	Cadmium	Chromium ⁽¹⁾	Copper	Lead	Mercury	Selenium	Silver	Zinc
RF-6 19-May-99 Diversion Ditch	Aquatic Wildlife Criteria ⁽²⁾	Chronic	0.19	0.004	0.812	0.049	0.026	0.000012	0.005	N/A	0.436
		Acute	0.36	0.026	0.81	0.085	0.683	0.0024	0.02	0.072	0.481
	Lab Results	Dissolved	<0.020	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.15
RF-6-2 9-Jun-99 75' Downstream of RF-6	Aquatic Wildlife Criteria ⁽²⁾	Chronic	0.19	0.004	0.812	0.049	0.026	0.000012	0.005	N/A	0.436
		Acute	0.36	0.026	6.81	0.085	0.683	0.0024	0.02	0.072	0.481
	Lab Results	Dissolved	<0.020	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.02
RF-7 19-May-99 Upstream Silver Creek	Aquatic Wildlife Criteria ⁽²⁾	Chronic	0.19	0.004	0.686	0.042	0.02	0.000012	0.005	N/A	0.363
		Acute	0.36	0.02	5.76	0.07	0.526	0.0024	0.02	0.05	0.405
	Lab Results	Dissolved	<0.020	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.51
RF-7-2 9-Jun-99 Upstream of RF-7	Aquatic Wildlife Criteria ⁽²⁾	Chronic	0.19	0.003	0.552	0.033	0.015	0.000012	0.005	N/A	0.292
		Acute	0.36	0.015	4.63	0.055	0.375	0.0024	0.02	0.032	0.322
	Lab Results	Dissolved	<0.020	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.89
RF-8 19-May-99 Downstream Silver Creek	Aquatic Wildlife Criteria ⁽²⁾	Chronic	0.19	0.004	0.686	0.041	0.02	0.000012	0.005	N/A	0.366
		Acute	0.36	0.02	5.76	0.07	0.526	0.0024	0.02	0.05	0.405
	Lab Results	Dissolved	<0.020	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.49
RF-8 9-Jun-99 Downstream Silver Creek	Aquatic Wildlife Criteria ⁽²⁾	Chronic	0.19	0.003	0.572	0.034	0.015	0.000012	0.005	N/A	0.303
		Acute	0.36	0.016	4.8	0.057	0.396	0.0024	0.02	0.032	0.335
	Lab Results	Dissolved	<0.020	0.003	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.85

⁽¹⁾ Aquatic Wildlife Criteria is based on Trivalent species of arsenic and chromium; the sample result is for all species of arsenic and chromium.

⁽²⁾ Utah Water Quality Standard for Stream Classification 3A (Aquatic Wildlife Criteria) for Dissolved Metals as related to Hardness

General Water Chemistry

Sample Location	Date	Alkalinity	Calcium	Chloride	Cation/Anion Balance	Carbonate	Bicarbonate	Hardness	pH (LAB)	Potassium	Magnesium	Nitrite/Nitrate	Sodium	Sulfate
RF-1	19-May-99	122	39	15	7.5	<1	122	135.27	7.5	<4	9.2	<0.1	18	20
RF-3	19-May-99	198	56	30	6.1	<1	198	197.48	7.8	<4	14	<0.1	32	23
RF-6	19-May-99	214	153	92	5.9	<1	214	530.29	7.7	<5	36	0.6	54	259
RF-6	9-Jun-99	-	187	-	-	-	-	644.01	-	<4	43	0.16	44	-
RF-7	19-May-99	140	122	220	<1	<1	140	432.3	8.2	<4	31	0.4	110	200
RF-7-2	9-Jun-99	-	98	-	-	-	-	331.18	-	<4	21	0.24	80	-
RF-8	19-May-99	142	126	222	<1	<1	142	446.4	8	<4	32	0.6	110	192
RF-8	9-Jun-99	-	102	-	-	-	-	345.29	-	<4	22	0.27	76	-
RF-9	19-May-99	96	82	300	7	4	92	287.11	8.4	6.2	20	0.2	177	50
RF-10	9-Jun-99	-	60	-	-	-	-	219.85	-	<4	17	0.1	47	-
-	-	Flow (cfs)												
RF-1	9-Jun-99	0.39												
RF-2	9-Jun-99	0.39												
RF-6	9-Jun-99	0.32												
RF-7-2	9-Jun-99	3.17												

Sample Results Compared to Domestic Use Criteria

Sample Location	Date	Type	Arsenic WQS*: 0.05	Barium WQS: 1	Cadmium WQS: 0.01	Chromium WQS: 0.05	Copper WQS: 1	Lead WQS: 0.05	Mercury WQS: 0.002	Selenium WQS: 0.01	Silver WQS: 0.05	Zinc WQS**
RF-1	19-May-99	Total	<0.020	0.16	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.027
		Dissolved	<0.020	0.15	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.047
RF-2	19-May-99	Total	<0.020	0.18	<0.001	<0.020	<0.010	0.005	<0.0005	<0.005	<0.010	0.038
		Dissolved	<0.020	0.17	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.042
RF-3	19-May-99	Total	<0.020	0.17	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.017
		Dissolved	<0.020	0.16	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.024
RF-4	19-May-99	Total	<0.020	0.09	0.002	<0.020	0.015	<0.005	<0.0005	<0.005	<0.010	1.1
		Dissolved	<0.020	0.14	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.95
RF-5	19-May-99	Total	<0.020	0.14	<0.001	<0.020	0.011	<0.005	<0.0005	<0.005	<0.010	0.9
		Dissolved	<0.020	0.14	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.85
RF-6	19-May-99	Total	<0.020	0.13	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.45
		Dissolved	<0.020	0.13	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.15
RF-6	9-Jun-99	Total	<0.020	0.17	0.003	<0.020	<0.010	0.028	<0.0005	<0.005	<0.010	0.85
		Dissolved	<0.020	0.18	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.85
RF-7	19-May-99	Total	<0.020	0.11	0.003	<0.020	0.013	0.074	<0.0005	<0.005	<0.010	0.82
		Dissolved	<0.020	0.1	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.51
RF-7-2	9-Jun-99	Total	<0.020	0.21	0.004	<0.020	<0.010	0.078	<0.0005	<0.005	<0.010	1.5
		Dissolved	<0.020	0.19	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.89
RF-8	19-May-99	Total	0.031	0.13	0.009	<0.020	0.038	0.34	<0.0005	<0.005	<0.010	1.7
		Dissolved	<0.020	0.1	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.49
RF-8	9-Jun-99	Total	<0.020	0.17	0.003	<0.020	<0.010	0.028	<0.0005	<0.005	<0.010	0.85
		Dissolved	<0.020	0.18	0.002	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.85
RF-9	19-May-99	Total	<0.020	0.14	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.011
		Dissolved	<0.020	0.13	<0.001	<0.020	<0.010	<0.005	<0.0005	<0.005	<0.010	0.029
RF-10	9-Jun-99	Total	0.021	0.26	<0.001	<0.020	<0.010	0.023	<0.0005	<0.005	<0.010	0.069
		Dissolved	<0.020	0.25	<0.001	<0.020	<0.010	0.009	<0.0005	<0.005	<0.010	0.009

*Utah Water Quality Standard for Stream Classification 1C (Domestic Use Criteria) for Dissolved Metals.

** There is no WQS for Stream Classification 1C for Zinc.

All units are in mg/L except Flow (cfs) and pH (standard units).

Table 5.2: Summary of Analytical Parameters for Water and Soil Samples

WATER SAMPLES

Analytical Parameters	Method	Reference
Metals		
Ag, As, Cd, Fe Cu, Pb, Sb, Se, Zn	SW-846 6010	EPA SW-846*
Hg	EPA 245.1 /1631	EPA Methods**
Ions		
Ca, K, Mg, Na	SW-846 6010	EPA SW-846*
Cl	EPA 325.2	EPA Methods**
Cation/Anion Balance	-	-
CO ₃ , HCO ₃	EPA 310.1	EPA Methods**
NO ₂ , NO ₃	EPA 353.2	EPA Methods**
SO ₄	SW-846 9036	EPA SW-846*
Other Parameters		
Alkalinity	EPA 310.1	EPA Methods**
pH (lab)	EPA 150.1	EPA Methods**
pH (field)	Digital pH Meter	RMC SOP
conductivity	Digital Meter	RMC SOP
Hardness	-	-
TSS	EPA 160.2	EPA Methods**
TDS	EPA 160.1	EPA Methods**

SOIL SAMPLES

Analytical Parameters	Method	Reference
Metals (Soil)		
Ag, As, Cd, Fe, Cu, Pb, Sb, Se, Zn	SW-846 6010	EPA SW-846*
Hg	SW-846 7471	EPA SW-846*
Metals (Sedimentary)		
Ag, As, Cd, Fe Cu, Pb, Sb, Se, Zn	XRF	-
Hg	SW-846 74.71	EPA SW-846*
Other Parameters		
Cation Exchange Capacity	SW-846 9081	EPA SW-846*
pH (lab)	SW-846 9045C	EPA SW-846*

* EPA SW-846 Test Methods for Evaluating Solid Waste, December, 1996

** EPA Methods for Chemical Analysis of Water and Waste, March, 1983

**APPENDIX A: The Weston Preliminary Hydrogeologic
Review of Richardson Flat Tailings Site**

NOTE: THIS DOCUMENT HAS BEEN PREVIOUSLY SUBMITTED TO THE AGENCIES IN THE DRAFT WORK PLAN SUBMITTED IN NOVEMBER, 1999. IT IS INCORPORATED INTO THIS DOCUMENT BY REFERENCE ONLY.

APPENDIX B: EPA Final Report, March 1993

FINAL REPORT
RICHARDSON FLATS TAILINGS
SUMMIT COUNTY, UTAH
TDD #T08-9204-015 and #T08-9210-050
PAN EUTO039SBA and EUTO039SDA

PREPARED FOR:

U.S. Environmental Protection Agency
Region VIII
Waste Management Division
Mike Zimmerman, On-Scene Coordinator

PREPARED BY:

Scott Keen
Ecology and Environment, Inc.
Technical Assistance Team

DATE SUBMITTED: February 19, 1993

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION AND PURPOSE.....	1
2.0 SUMMARY AND RECOMMENDATIONS.....	2
3.0 SITE ACTIVITIES.....	3
4.0 RESULTS AND FINDINGS.....	4
4.1 Air Monitoring.....	4
4.2 Tailings Assessment.....	4
4.2.1 Depth of Cover.....	4
4.2.2 Cover Soil Analyses.....	5
4.2.3 Tailings Containment.....	6
4.2.4 Surface Water.....	8
4.2.5 Groundwater.....	9
4.2.6 Sediment.....	10
4.3 Landfill Assessment.....	11
4.3.1 Groundwater.....	11
4.3.2 Surface Water.....	12
4.4 Site Access.....	13

APPENDICES

APPENDIX A	MEMORANDUM TO EPA/OSC DATED AUGUST 6, 1992, INSPECTION OF THE TAILINGS DAM AT RICHARDSON FLATS
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LIST OF FIGURES

FIGURE 1	SAMPLE LOCATION MAP
FIGURE 2	SOIL COVER DEPTH DETERMINATION AND SAMPLE LOCATION

LIST OF TABLES

TABLE 1	COVER DEPTH MEASUREMENT
TABLE 2	INORGANIC ANALYTICAL RESULTS FOR SOIL
TABLE 3	INORGANIC ANALYTICAL RESULTS FOR SURFACE WATER
TABLE 4	NUMERIC STANDARDS OF QUALITY, SILVER CREEK
TABLE 5	FEDERAL QUALITY CRITERIA FOR WATER
TABLE 6	INORGANIC ANALYTICAL RESULTS FOR GROUNDWATER, TAILINGS AREA
TABLE 7	INORGANIC ANALYTICAL RESULTS FOR SEDIMENT
TABLE 8	INORGANIC ANALYTICAL RESULTS FOR GROUNDWATER, LANDFILL AREA
TABLE 9	LIST OF INORGANIC DATA QUALIFIERS

FINAL REPORT
RICHARDSON FLATS TAILINGS SITE
TDD #T08-9204-015 and #T08-9210-050
PAN EUT0039SBA and EUT0039SDA

1.0 INTRODUCTION AND PURPOSE

This report is written to satisfy the requirements of Technical Direction Documents (TDDs) #T08-9204-015 and T08-9210-050 issued to the Ecology and Environment, Inc. Technical Assistance Team (E & E-TAT) by the Region VIII U.S. Environmental Protection Agency (USEPA) Emergency Response Branch (ERB). This work was begun in April 1992. Other reports submitted by the TAT under this TDD include: "Trip Report, Richardson Flats Tailings Site, August 17, 1992"; and "Inspection of the Tailings Dam at Richardson Flats, Memorandum to EPA-OSC", August 6, 1992. Within this same time frame the TAT has also performed work relevant to the site under three separate TDDs (T08-9204-041, T08-9207-019 and T08-9210-041). Reports/documents generated by the TAT as a result of these three TDDs are: the "Report of Drilling Activities, Richardson Flats Tailings Site, July 13, 1992"; "Response to PRPs September 10, 1992 Memorandum Regarding Well Installation Activities, Memorandum to EPA/OSC, September 11, 1992"; and "Report of Sampling Activities, January 4, 1993".

Also relevant to this work is the report entitled "Air Sampling and Analysis, Final Report", August 1992, prepared by the Environmental Response Team (ERT) of the USEPA.

The Richardson Flats Tailings site is located three and one-half miles northeast of Park City, Summit County, Utah. On approximately 160 acres from 1975 through 1981 mine tailings were placed by slurry pipeline from mines owned by United Park City Mines (UPCM). A small portion of the site was also used for a municipal/sanitary landfill during the mid-1970s.

The Richardson Flats Tailings site appeared in the Federal Register on February 7, 1992 as a proposed National Priorities List (NPL) site. Because of this proposed listing the USEPA/ERB became responsible for assuring immediate site safety for the interim period following proposed listing through the initiation of remedial activities. The purpose of this work has thus been to examine the site in terms of immediate threats to human health or the environment. This report is a summary of findings to that end.

2.0 SUMMARY AND RECOMMENDATIONS

Four areas of concern at the Richardson Flats Tailings site have been examined to determine immediate threats to human health or the environment. These four areas are: 1. the airborne release of contaminants; 2. the release of contaminants from the tailings area; 3. the release of contaminants from the municipal/sanitary landfill area; and 4. site access. In general, the site presents little or no immediate threat to human health or the environment. Following is a summary of specific findings and specific recommendations to assure site safety in the interim period preceding remedial activities.

Findings

- o Airborne releases of metal contaminants from the tailings area have been minimized and do not pose an immediate threat.
- o Existing soil and salt grass cover over the tailings area are providing adequate dust suppressing capability to prevent an immediate threat of airborne contaminant releases. For the long term however, soil cover is sparse and salt grass may disappear as the site becomes drier. In the long term, dusty conditions may recur.
- o Soil being used by UPCM for tailings cover does not contain contaminants at concentrations that pose an immediate threat to human health or the environment.
- o There is no immediate threat of gross failure of the tailings containment structure. There is seepage, however, through and/or around the dam end of the structure. In the summer of 1992, a hillside diversion ditch on the north perimeter of the tailings area had also been cut off from the main drainage ditch. This could permit runoff into the tailings area.
- o During the period of this assessment, surface water flow and runoff from the tailings area was very low. Almost no contaminants attributed to the site could be documented entering local surface water. The exception was the documentation of a release of lead (151 µg/l) to Silver Creek from the site. Although this release is a very important finding, it is not considered an immediate threat to human health and the environment. This release would be better addressed by a comprehensive remedial plan rather than by emergency response actions.
- o The placement of tailings has contributed to a significant rise in total dissolved solids (TDS) of shallow groundwater. Concentrations of individual metal contaminants do not increase to significant levels within shallow groundwater near the tailings area.
- o Sediment in the "wetlands" area of the site between Silver Creek and the base of the tailings dam is severely contaminated with

tailings material and the associated high levels of metals (arsenic, cadmium, lead,). Because this area is six to eight feet above Silver Creek and surface water flow through it is from the diversion ditch and from seepage through the tailings containment structure, this sediment contamination appears directly attributable to the site. Although this is a very significant finding, contaminated sediment is relatively immobile and the result of a long term process. It is not considered an immediate threat and would be better addressed by a comprehensive remedial plan rather than by emergency response actions.

- o In the area of the municipal/sanitary landfill, no organic or inorganic contaminants that could be attributed to the site were detected in surface water.
- o Shallow groundwater in the area of the municipal/sanitary landfill showed no organic contaminants attributed to the site; however, TDS and arsenic concentrations do show increases which are attributed to the site.
- o Site access has been satisfactorily limited by a security fence surrounding the site.

Recommendations

- o Although serious environmental concerns have been documented at the Richardson Flats Tailings site, this report does not recommend that any of these concerns be addressed with emergency response actions as immediate threats to human health or the environment. The concerns of surface water, groundwater, and sediment contamination and potential airborne releases of metals documented by this and other studies are problems which have existed for many years. The severity of these problems will not increase dramatically but will persist at a steady level. This report recommends that all concerns at the Richardson Flats Tailings site be addressed through the comprehensive remedial planning process which NPL sites are subject to. The body of this report should clarify some of the site concerns and should assist in developing the remedial plans.

3.0 SITE ACTIVITIES

Following an initial site visit in April 1992, the TAT prepared a work plan to assess contaminant releases to groundwater, surface water, and to the local environment via the air pathway. Contaminants of concern include metals from the tailings area and the landfill area, and several types of potential organic contaminants from the landfill area.

Additional monitoring wells were installed at the site during the week of June 27, 1992. Air monitoring was conducted by the ERT on June 10 and 11, 1992. During the week of August 3, 1992 the TAT was on-site for several activities including groundwater and surface water sampling, determination of depth of cover on the tailings area, sampling of cover

soil material, and inspection of the tailings containment structure and diversion ditch system. Additional groundwater sampling occurred during the week of November 9, 1992.

4.0 RESULTS AND FINDINGS

7. July 86 data

4.1 AIR MONITORING

In July 1986 air monitoring documented the airborne release of arsenic, cadmium, lead, and zinc in particulate form from the Richardson Flats Tailings site. Since that time UPCM has placed cover soil over approximately 85% (UPCM's estimate) of the tailings area. On June 10 and 11, 1992 air samples were again collected to assess the airborne release of these four metals. At 5 sampling locations on the site's perimeter boundary 17 air samples were collected. The sampling procedure and analytical results are contained in their entirety in the Air Sampling and Analysis, Final Report, Richardson Flats, August 1992, prepared by the USEPA/ERT. In summary, these air monitoring activities showed no detectable levels of cadmium, lead, or arsenic in any samples. Trace levels of zinc (at the level of quantitation) were detected in four samples only. No samples on any day under any wind condition exhibited elevated levels of contaminants. Restriction from site access precluded the implementation of the optimum sampling strategy; however a conclusion can still be made that airborne releases of contaminants from the Richardson Flats Tailings site are not posing an immediate threat to human health or the environment.

4.2 TAILINGS ASSESSMENT

4.2.1 DEPTH OF COVER

Depth of cover was determined at 29 locations over the tailings area. These locations are depicted on Figure 2. Locations were determined by first establishing a reference line in an approximate direction of northwest to southeast through the tailings area (Figure 1). This reference line includes and is a continuation of a straight portion of the tailings containment structure as shown in Figure 1. Points were marked along this reference line at 200 or 400 foot intervals. At 2800 feet from the base point a second reference line was established in a perpendicular direction to the first reference line. This second reference line extended in an approximate direction from southwest to northeast. For the purpose of sampling or soil cover measurements, all locations within the tailings area were identified relative to these two reference lines. For example, a sample location identified as 1900, 800L would be 1900 feet from the base point (using the first reference line) and 800 feet to the left (northeast) using the second reference line.

Sample locations were on an approximate grid pattern of 400 feet x 400 feet. The grid covered most of the tailings area. Table 1 presents the results of cover depth measurements. At all but one location a distinct line could be seen between soil cover and gray colored tailings beneath the cover. X-ray fluorescence (XRF) measurements for lead were taken to confirm the visual determination of cover depth or to determine

cover depth where a distinct line was not visible. As seen in Table 1, much of the tailings area is covered with a salt grass. This is a native grass which appeared to form an excellent cover on the tailings. Where the salt grass is present no soil cover had been placed over the tailings; however roots of the grass extended five to six inches below ground surface, and the roots and the grass itself formed an effective dust suppressing mat on top of tailings material.

The grid pattern shown in Figure 2 represent much of the entire tailings area. Of the 29 points on this grid only 1 point had no cover soil and no salt grass present. Nine of the 29 points (approximately 30 percent) had no cover soil present. At the 20 points where cover soil was present, the cover soil was 6 inches thick or less at 6 points and greater than 6 inches in thickness at 14 points.

It is important to note that the salt grass which became established on the tailings area is likely dependent upon a moist environment for survival. This grass became established when tailings were slurried to the site creating periods of standing water. The grass may slowly disappear, and its extensive root system may make conditions difficult for other plants to become established.

UPCM has expressed intentions of adding soil cover to that small portion of the site which currently has no soil cover or where salt grass is not established. When this is completed, the tailings area will have adequate cover to prevent an immediate threat of excessive dust. Much of the existing soil cover, however, is sparse (less than six inches in thickness); and much of the area is covered with a salt grass that may disappear as the site becomes drier. Dusty conditions could recur in the future if proper soil cover over the entire tailings area is not applied.

4.2.2 COVER SOIL ANALYSES

Figure 2 shows the location of six soil samples collected on August 6, 1992. Each of these samples, except sample RF-SO-3, was taken from soil that was added by UPCM as cover to the site. Table 2 contains analytical results for these samples and the normal ranges for these elements in soils of the western United States. Sample RF-SO-3 was collected within an area covered by salt grass. As discussed, where salt grass is currently established soil cover has not been added by UPCM. This soil sample is more likely to be representative of tailings material.

As Table 2 shows, constituents of soil cover do not consistently fall into the normal ranges for all elements. In soil cover samples, however, no contaminant is grossly out of line from the normal ranges presented in Table 2. Results for sample RF-SO-03 show very high concentrations of antimony, arsenic, cadmium, copper, lead, mercury, selenium, and zinc; however this sample is tailings, not cover material. It appears that soil being used for cover material by UPCM does not contain contaminants at concentrations that would pose an immediate threat to human health or the environment.

4.2.3 TAILINGS CONTAINMENT

On August 4, 1992 the TAT inspected the tailings containment structure. This inspection did not include trenching or boring into the embankment and thus was not a full assessment of the structure. Results of this inspection were summarized in a memorandum to the OSC dated August 8, 1992. This memo is included with this report as Appendix A. Important findings of this inspection follow.

1. Main Embankment.

The main embankment is oversteep lying at 1.0:1.0 to 1.5:1.0 (run:rise). Approximately six inches of fine dry sand, possibly windblown tailings, were noted under a three inch topsoil cover layer on the downstream face of the embankment. The sand has no strength and will erode quickly if exposed. A 35% to 50% grass cover was on most of the embankment which will help in erosion control. No cracking was evident on the embankment, although the sand layer would tend to hide any small cracking. Also, no bending (bulging) was noted on the embankment.

2. Toe of the Main Embankment.

Rank vegetation, in the form of willows and trees, is growing at the toe of the dam. Approximately eight inches of loamy damp soil is evident on the toe of the dam. The amount of vegetation and the type of soils on the toe of the dam indicate that the area receives a lot of water. As wet soils were noted approximately six to eight feet above the stream level this water is probably due to seepage under the dam. Other evidence of seepage from the toe of the dam was evident in the forms of; soft marshy areas, rank vegetation including willows, loamy soils, damp soils, and areas where water had been standing (although no standing water was observed on August 4, 1992).

3. The North Abutment.

A swampy, loamy area on the north abutment, adjacent to where the embankment meets the abutment, was noted. The area was well above the toe of the dam at the location of the north monitoring well. This well recharged quickly when bailed. These conditions indicate that water seeps around or through the contact between the abutment and the embankment. Under full head conditions (saturated tailings) this would be an area where failure of the embankment could occur.

4. Crest of the Main Embankment.

The crest is sloped back toward the tailings area allowing any water to drain back to the tailings pond. However, small erosional gullies are forming on the crest and downstream face of the dam and could eventually lead to larger gullying on the dam.

5. Water Flow.

Water elevations behind the embankment are unknown, however the elevation of water in the ditch and the pond south of the tailings area are probably indicative of the elevation of

groundwater behind the embankment. From the information available in the Dames & Moore, Inc. reports, it is unlikely that a cutoff wall was installed around the perimeter of the pond to control seepage under either the embankment or the dike. The piezometer located on the toe of the dam indicated the water level to be five feet below ground surface. The swampy ground and recharge rate of the monitoring well on the north abutment indicates that water flow from some source is occurring. Inspection of the road cut north of the abutment revealed no seeps. Without further investigation it is conservative to use a worst case scenario and assume that the source of the seep is the water in the tailings behind the dam and that the abutment/embankment contact is a drainage path for the water.

6. Perimeter Dike.

The perimeter dike was probably constructed by stripping materials off of the downstream side and piling the undifferentiated material up as a dike. The slopes are approximately 2.0:1.0. The dike is used as the access road for the pond and its elevation varies from two to five feet above the level of the tailings in the pond. The dike appears to be in good condition.

7. Diversion Ditch.

A diversion ditch has been constructed along the perimeter of the tailings pond as designed by Dames & Moore, Inc. The ditch depth and width varies, generally getting deeper and wider as it progresses downstream. Standing water was evident in most of the ditch on the southern perimeter of the property. Rushes, sedges, and cattails were growing in the bottom of the ditch along the entire length. Recent work has been performed by the owners in flattening the ditch banks and adding topsoil to the banks. This work is approximately one-half completed. According to the owners, the rest of the ditch is to be similarly regraded and topsoiled. At the time TAT inspected the site, the hillside diversion ditch, on the north perimeter of the tailings pond, had been cut off from the main ditch as a result of topsoil stripping. This important feature should be reconnected to the main ditch as soon as possible to prevent additional water flowing into the tailings pond.

In conclusion, based on the observed conditions of the tailings containment or embankment structure and the relatively dry condition of the tailings, there is no immediate threat of gross failure of this structure. Of more immediate concern are: seepage from the toe of the dam evidenced by wet/saturated soil well above stream level; seepage around or through the contact between the abutment and the embankment near the location of the northernmost groundwater monitoring well; and the hillside diversion ditch located on the north perimeter of the tailings area which has been cut off from the main drainage ditch by topsoil stripping activities allowing runoff into the tailings area.

Recommendations include keeping the tailings area dry through the maintenance of the diversion ditches. The connection between the

hillside diversion ditch and the perimeter diversion ditch should be restored.

4.2.4 SURFACE WATER

Surface water samples collected for assessment of the tailings area are shown on Figure 1. These eight sample numbers are RF-SW-01 through RF-SW-08. Inorganic analytical results for surface water samples are presented in Table 3. Within Silver Creek samples RF-SW-01 through RF-SW-04 are considered upgradient of the tailings area and samples RF-SW-05 and RF-SW-06 are downgradient. In comparing upgradient sample results with downgradient sample results very few significant differences are noted. Lead increases by a factor of 5.7 in sample RF-SW-05 when compared to the average lead concentration of the four upgradient samples. In sample RF-SW-06 arsenic increases by a factor of 2.1 and silver increases by a factor of 4.2 when compared to the average concentration of the four upgradient samples.

It is important to realize that within surface water most metals will be quickly oxidized, precipitate, and tend to settle out of the bulk water and become incorporated into stream sediment. Thus, metals in surface water generally are transported in particulate/suspended form. In a very low flow period of the year (August), when surface water is not turbulent, metals are not transported to the extent that they are transported during higher flow conditions.

The Utah Code, 26-11-2 through 20, has classified the Weber River from the Stoddard diversion to the headwaters (including Silver Creek) in the following manner: 1C-protected for domestic purposes with prior treatment by treatment processes as required by the Utah Department of Health; 3A-protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain; and 4-protected for agricultural uses including irrigation of crops and stock watering. The Utah Code establishes specific numeric criteria for contaminants based upon use classification.

Applicable inorganic standards from the State Code are summarized in Table 4. The Utah Code prohibits discharges or placement of wastes in such a manner that will cause violations of these numerical standards. The State has designated Silver Creek to be in three use classes (1C, 3A, and 4). For the domestic source class (1C) upgradient samples from Silver Creek meet all standards. The two downgradient Silver Creek samples meet all standards except for lead in sample RF-GW-05. The data indicates that during this sampling event a violation of the lead standard for the State Domestic Source (1C) surface water class was caused by discharges from the Richardson Flat tailings site. For the Agricultural Class (4) the data also indicates a violation of the lead standard in sample RF-SW-05.

State standards for Class 3A Surface Waters, protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain, are divided into four day average (chronic) standards and one hour average (acute) standards. Grab samples collected during the week of August 4, 1992

could only be compared to the acute standards. This comparison shows that upgradient and downgradient samples from Silver Creek meet all Class 3A standards, except those standards for lead and zinc which are exceeded in both upgradient and downgradient samples.

The State Code also contains numeric standards for surface waters for the protection of human health. Those applicable inorganic standards are also presented in Table 4. All upgradient and downgradient samples from Silver Creek meet the human health standards for antimony, cadmium, chromium, copper, silver, selenium, and zinc. Both upgradient and downgradient samples fail to meet human health standards for arsenic and beryllium. One upgradient sample, RF-SW-02, does not meet the human health criteria for nickel. One downgradient sample, RF-SW-05, does not meet the human health standard for lead.

What is important to this report when examining inorganic analytical data for Silver Creek and when considering the several state standards for the protection of surface waters? The detection of lead in one downgradient sample at 151 ug/l is likely the most significant observation. This lead level and the relatively low lead concentration in the four upgradient samples constitutes a violation of the State Code for protection of Class 1C and Class 4 surface waters. Sample RF-SW-05 also demonstrates a violation of the state standard for protection of human health. This sample may help to confirm the findings of earlier studies or highlight an area of concern for later remedial activities. In the context of this project, however, this observation of an elevated lead level in one of two downgradient surface water samples cannot be seen as posing an immediate threat to human health or the environment. A "release" has been documented, however the documentation of an ongoing event is sparse.

4.2.5 GROUNDWATER

One upgradient and two downgradient monitoring wells (Figure 1) were sampled during the week of August 4, 1992. Results of inorganic analyses are presented in Table 6. Sample RF-GW-04 is from the upgradient well; samples RF-GW-05 and RF-GW-09 are from two wells at the base of the tailings dam.

Calculation of total dissolved solids (TDS) level of the upgradient well shows upgradient groundwater to contain less than 500 parts per million (ppm) TDS. This finding is consistent with upgradient TDS concentrations found during previous sampling activities in August 1985.

State of Utah Wastewater Disposal Regulations, Part II, Standards of Quality for Waters of the State establishes classes of groundwater. If only filtered samples are considered, upgradient groundwater would be classified 1A, Pristine Groundwater. If unfiltered samples are evaluated, upgradient groundwater would be classified III, Limited Use Groundwater. State regulations also establish protection criteria which prohibit discharges to groundwater that would cause violations of the numeric groundwater quality standards.

Comparison of upgradient versus downgradient water quality from Table 6 shows that no individual contaminants increase to concentrations that would cause violations of either Class 1A or Class III groundwater protection standards. TDS levels, however, show increases (downgradient versus upgradient) well in excess of the protection standards for either Class 1A or Class III groundwaters. This increase in TDS of groundwater is attributed to the influence of tailings material on water chemistry and constitutes a violation of state regulations pertaining to the protection of groundwater quality.

4.2.6 SEDIMENT

Figure 1 shows a "wetlands" area between the base of the tailings dam and Silver Creek. Within this area four sediment samples were collected. Results of inorganic analyses of these samples is presented in Table 7 along with the normal ranges of elemental concentrations in soils of the western United States.

Analytical results show the following. Antimony is present at levels 39 to 98 times higher than the normal maximum concentration in soils of the western United States. Arsenic is present at levels 11 to 28 times higher than the normal maximum concentration in soils of the western United States. Cadmium is present at levels 75 to 210 times higher than the normal maximum concentration in soils of the western United States. Lead is present at levels 75 to 210 times higher than the normal maximum concentration in soils of the western United States. Mercury is present at levels 11 to 74 times higher than the normal maximum concentration in soils of the western United States. Selenium is present at levels 17 to 76 times higher than the normal maximum concentration in soils of the western United States. Zinc is present at levels 55 to 410 times higher than the normal maximum concentration in soils of the western United States.

Water flow through the wetlands area is now primarily from the diversion ditch. Some seepage from the tailings area through or around the containment structure may also influence flow and/or chemistry of this wetlands (See Report Section on Tailings Containment). Flow is toward Silver Creek, and this badly contaminated sediment appears to be tailings material that is being transported from the site.

In Table 2, Inorganic Analytical Results for Soil, sample RF-SO-03 was a sample of tailings material. This tailings sample showed the following ratio of six elements: arsenic (4.3); cadmium (1); calcium (713); iron (811); lead (70); and zinc (120). In Table 7, Inorganic Analytical Results for Sediment, the four sediment samples plus one duplicate, when averaged, show the following ratio of the same six elements: arsenic (3.1); cadmium (1); calcium (904); iron (805); lead (72); and zinc (162). These ratios of elements are very similar and likely indicate that sediment in the wetlands area is tailings material from the site.

4.3 LANDFILL ASSESSMENT

4.3.1 GROUNDWATER

Three monitoring wells were installed in the area of the landfill during the week of June 22, 1992. These wells were sampled during the week of November 9, 1992. Sample locations are shown on Figure 1. Results of inorganic analyses are presented in Table 8. This table also contains results from a rinsate blank taken during sample collection and, for reference, results from RF-MW-04, a distant background monitoring well.

As shown in Figure 1, the three monitoring wells (1, 2 and 3) in the area of the municipal/sanitary landfill roughly surround the landfill. Analytical results confirm that sample location RF-MW-01 is hydraulically upgradient to sample locations RF-MW-02 and RF-MW-03. Estimates of total dissolved solids (TDS) for this upgradient monitoring well show that upgradient groundwater TDS is well below 500 ppm. Based on the inorganic analytical results of Table 8 and a TDS value of less than 500 ppm, groundwater immediately upgradient of the landfill is classified as Class 1A, Pristine Groundwater, by the State of Utah Groundwater Quality Standards.

State protection levels for Class 1A groundwaters are very rigid. Utah standards include the following requirements for Class 1A groundwaters.

1. TDS may not increase above 1.1 times the background value.
2. In no case will the TDS increase above 500 ppm.
3. When a contaminant is present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed 1.1 times the background concentration or exceed 0.1 times the groundwater quality standard whichever is greater.
4. When a contaminant is not present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed 0.1 times the groundwater quality standard value, or exceed the limit of detection whichever is greater.
5. In no case will the concentration of a pollutant be allowed to exceed the groundwater quality standard.

Comparison of the background sample, RF-MW-01, with the two downgradient sample locations, RF-MW-02 and RF-MW-03, shows the following.

1. TDS levels in groundwater increase in downgradient locations to concentrations above 500 ppm.
2. Of specific inorganic contaminants, arsenic shows the most significant increase in concentration from upgradient to downgradient samples. Arsenic was below 5.0 ppb or undetected in the upgradient sample (RF-GW-01). Dissolved arsenic was 24 ppb in RF-MW-02 and 59 and 70 ppb in two samples from RF-GW-03. The state groundwater quality standard for arsenic is 50 ppb. This is a clear violation of state groundwater

protection requirements which can be attributed to the landfill.

The groundwater samples taken from the area of the landfill were also analyzed for organic contaminants (volatiles, base-neutral acid extractable compounds, and pesticides/PCBs). Analytical results or organic analyses are not tabulated in this report but can be summarized as follows.

1. Five volatile compounds (toluene, methylene chloride, benzene, acetone, 1,2-dichloroethene) were found in one or more samples at very low concentrations. These concentrations were below the contract required detection limit of 10 ppb and cannot be considered significant.
2. Three base-neutral acid extractable compounds were found in one or more samples at very low concentrations. The three compounds were phthalate compounds present at 1 to 2 ppb. These analytical findings were not significant because the compounds were also detected in laboratory blanks or the concentrations found were below the contract required detection limits. Phthalates are common laboratory contaminants.
3. No pesticide or PCB was detected in any of the groundwater samples (RF-MW-01, RF-MW-02, RF-MW-03).

4.3.2 SURFACE WATER

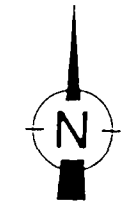
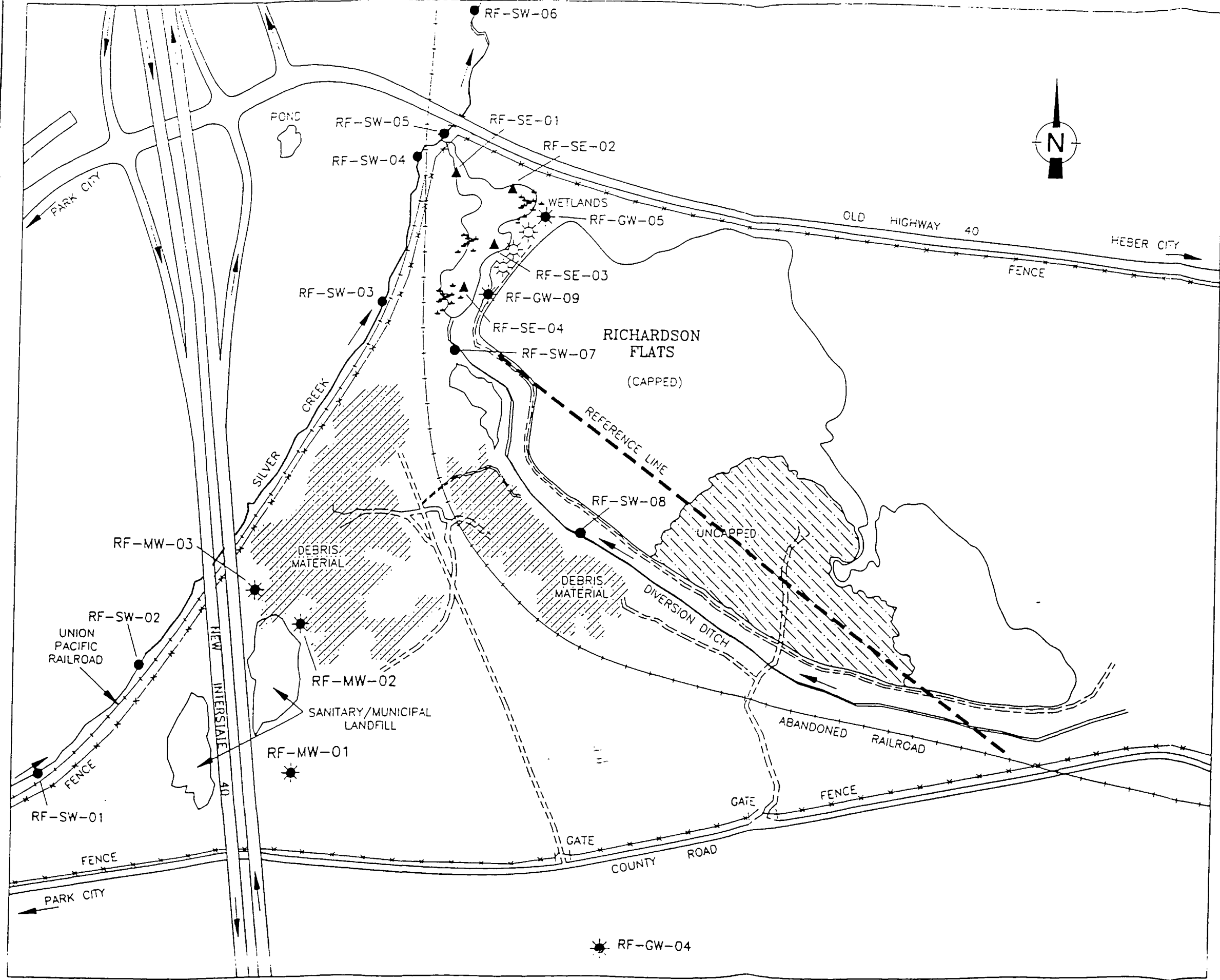
Of the six surface water sample locations shown in Figure 1, two locations (RF-SW-01 and RF-SW-02) were upgradient of the landfill; the other locations were downgradient. Comparison between upgradient and the two closest downgradient samples (RF-SW-03 and RF-SW-04) of inorganic data (Table 3) show no significant increases in contaminant concentrations as Silver Creek flows past the landfill.

These six surface water samples were also analyzed for organics (VOAs, BNAs, Pesticides/PCBs). In all samples no pesticide/PCBs were detected at or above the instrument detection level. One BNA compound, bis(2-ethylhexyl)phthalate, Cas Number 117-81-7, was detected at concentrations between 0.6 and 1 ppb at sample locations RF-SW-01, RF-SW-02, RF-SW-03, and RF-SW-04. This compound is a very common laboratory contaminant. At the very low levels detected its presence cannot be considered significant. Toluene was detected at 3 ppb at three sample locations, RF-SW-01, RF-SW-02, and RF-SW-03. At these very low concentrations the presence of toluene is not a certainty; however because two of the three sample locations were upgradient of the landfill, the presence of this contaminant would not be attributed to the landfill.

In summary, no significant findings came from the organic analyses of surface water samples.

4.4 SITE ACCESS

A security fence has been put in place surrounding the site. Based upon the TAT's inspections and observations during site activities and based upon observations made by UPCM this security fence has been very effective at preventing access to the site. Before the security fence was constructed, the site was most notably used by "off road" motorcycle enthusiasts.

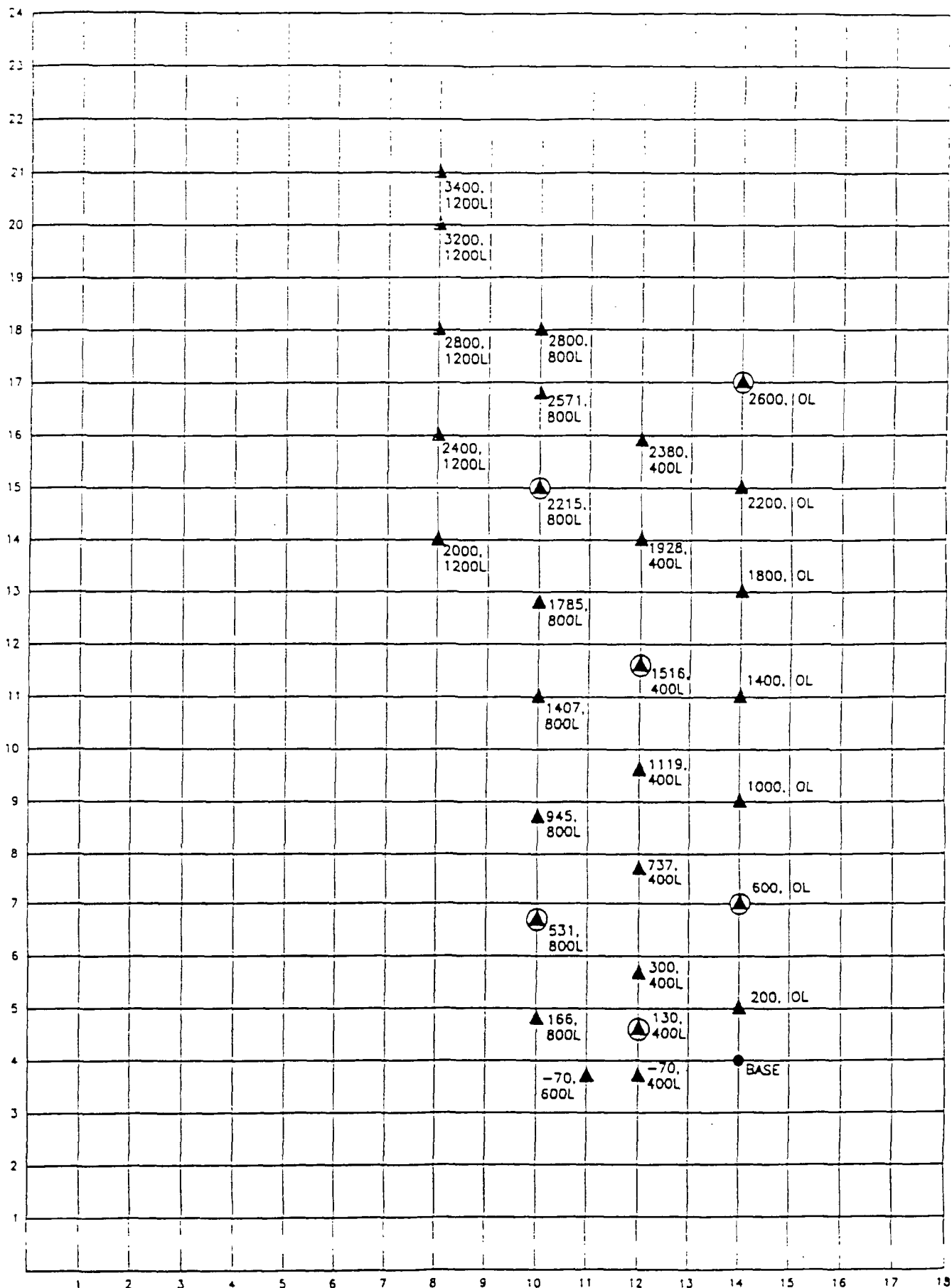


LEGEND

- ☼ Approximate location of monitoring wells
- ☼ Groundwater sample location
- Surface water sample location
- ▲ Sediment sample location

0 160 320 640
Approximate Scale

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION EPA CONTRACT 68-WO-0037	
TITLE: RICHARDSON FLATS Park City, Utah SAMPLE LOCATION MAP T.D.D. T08-9204-015	
ecology & environment, inc. DENVER, COLORADO	FIG. 1
Date: 08/92 Drawn by: RSM Scale: _____	



LEGEND

▲ Cover depth determined

⊙ Cover sample collected

Figure 2

RICHARDSON PLATS

TABLE 1
COVER DEPTH MEASUREMENT
RICHARDSON FLAT TAILINGS SITE
TDD #T08-9204-015

LOCATION	DEPTH OF COVER	VISUAL CONFIRMATION	XRF CONFIRMATION	XRF SAMPLE NUMBERS
200, 0L	10"	Yes	Yes	RF020, 021
600, 0L	3-6"	Yes	Yes	RF022,023,024,025
1000, 0L	>18"			
1400, 0L	>18"			
1800, 0L	>18"			RF026
2200, 0L	0-6"	No	Yes	RF027,028,029,030
2600, 0L	6-10"	Yes	Yes	RF032,033,034,035
2380, 400L	8-9"	Yes	Yes	RF036,037,038,039
1928, 400L	5-6"	Yes	Yes	RF040,041,042
1516, 400L	>6"			
1119, 400L	4"	Yes	Yes	RF044,045
737, 400L	7-8"	Yes	Yes	RF048,049,050
330, 400L	8"	Yes	Yes	RF055,056
2800, 800L	No Cover (Salt Grass)	Yes	Yes	RF057,058,059,060
2571, 800L	No Cover (Salt Grass)	Yes	Yes	RF061,062
2215, 800L	No Cover (Salt Grass)	Yes	Yes	RF063,064
1785, 800L	No Cover (Salt Grass)	Yes	Yes	RF065,066
1407, 800L	3"	Yes	Yes	RF067,068,069
945, 800L	6-7"	Yes	Yes	RF071,072,073
531, 800L	7-8"	Yes	Yes	RF074,075
166, 800L	No Cover	Yes	Yes	RF076,077
130, 400L	2"	Yes	Yes	RF080,081,082
-70, 400L	6.5"	Yes	Yes	RF083,084,085
-70, 600L	11"	Yes	Yes	RF086,087,088,089
2000, 1200L	No Cover (Salt Grass)	Yes	Yes	RF091,092
2400, 1200L	No Cover (Salt Grass)	Yes	Yes	RF093,094
2800, 1200L	No Cover (Salt Grass)	Yes	Yes	RF095,096
3200, 1200L	No Cover (Salt Grass)	Yes	Yes	RF097,098
3400, 1200L	>10"	Yes	Yes	RF099,100

TABLE 2
RICHARDSON FLATS TAILINGS
INORGANIC ANALYTICAL RESULTS FOR SOIL
CONCENTRATION IN mg/kg
TDD #T08-9204-015

ANALYTE	NORMAL RANGE (mg/kg) *	RF-SO-01	RF-SO-02	RF-SO-03	RF-SO-04	RF-SO-05	RF-SO-06
Aluminum	29000-116000	21200	25300	2960	25800	22000	25200
Antimony	0.22-1.01	5.0U	5.0U	142J	5.0U	5.7NJ	5.6NJ
Arsenic	2.8-10.9	20.9J	3.5J	357J	5.9J	16.6J	8.9J
Barium	337-998	253	282	117	267	317	197
Beryllium	0.30-1.56	1.1	1.1	1.2	1.2	1.1	1.2
Cadmium	0.01-2.0***	3.0J	1.8J	83.0J	1.9J	5.0J	2.4J
Calcium		5850	5900	59200	5900	9480	4920
Chromium	19-90	24.4J	27.9J	12.9J	22.2J	24.3J	28.2J
Cobalt	3.6-14.0	13.9	12.7	12.6	15.0	14.5	10.0B
Copper	10-43	31.4	24.8	454	27.2	50.4	29.4
Iron	10600-41000	21800	25600	67300	23500	27500	23100
Lead	9-31	111	34.9	5770	125J	223	102
Magnesium		4910	5200	10100	5150	4780	5570
Manganese	192-752	1190	637	2020	899	1030	697
Mercury	0.02-0.11	0.11U	0.11U	3.6J	0.10U	0.11U	0.16J
Nickel	7-32	20.7	21.6	18.5	18.4	21.3	19.9
Potassium		4730	4580	917	4330	4540	5650
Selenium	0.09-0.56	0.61U	0.61J	25.4J	0.61U	0.61U	0.61U
Silver	0.01-8***	4.1J	2.0J	20.3J	2.0J	2.0J	2.0J
Sodium		136NJ	319NJ	209NJ	244NJ	248NJ	159NJ
Thallium	0.1-0.8***	0.35NJ	0.43NJ	41.7	0.59NJ	1.9NJ	0.32U
Vanadium	36-136	41.4	56.3	13.0	51.4	57.4	42.2
Zinc	31-98	214	96.3	10000	127	432	184

* Data From: Shacklette, H.T., and Boerngen J.G., 1984; Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270, 105pp.

*** - Bowen, H.J.M., 1979, Environmental Chemistry of the Elements, Academic Press, NY.

TABLE 3
 RICHARDSON FLATS TAILINGS
 INORGANIC ANALYTICAL RESULTS FOR SURFACE WATER
 CONCENTRATION IN µg/l
 TDD #T08-9204-015

ANALYTE	RF-SW-01	RF-SW-02	RF-SW-03	RF-SW-04	RF-SW-05	RF-SW-06	RF-SW-07	RF-SW-08
Aluminum	20.3NJ	70.1NJ	19.3NJ	65.5NJ	17.1U	185NJ	36.7NJ	319
Antimony	36.7NJ	24.8NJ	24.3U	38.7NJ	24.3U	30.1NJ	24.3U	24.3U
Arsenic	4.2NJ	5.2NJ	7.3NJ	7.6NJ	7.2NJ	12.5J	5.7NJ	11.4J
Barium	49.2NJ	54.6NJ	50.5NJ	54.4NJ	65.6NJ	66.0NJ	32.7NJ	54.3NJ
Beryllium	3.4NJ	2.8NJ	2.1NJ	2.1NJ	2.4NJ	0.93NJ	3.2NJ	1.0NJ
Cadmium	3.9NJ	3.3U	3.3U	3.5NJ	3.3U	3.3U	3.3U	3.3U
Calcium	233000	157000	128000	149000	163000	146000	341000	190000
Chromium	7.8U	7.8U	7.8U	7.8U	7.8U	7.8U	7.8U	7.8U
Cobalt	6.0U	6.0U	6.0U	10.4NJ	6.0U	6.0U	6.0U	6.0U
Copper	20.0U	20.0U	20.0U	20.0U	20.0U	20.0U	20.0U	20.0NJ
Iron	193	158	307	356	279	446	703	1320
Lead	35.3J	18.8J	15.0J	36.4J	151J	33.2J	33.3J	146J
Magnesium	38700	37000	30600	33600	36700	37700	61000	38100
Manganese	249J	495J	458J	438J	269J	399J	9230J	1590J
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.24	0.20U
Nickel	11.1U	25.4NJ	11.1U	11.1U	11.1U	11.1U	12.8NJ	20.9NJ
Potassium	3510NJ	2110NJ	1640NJ	1950NJ	1270NJ	1400NJ	3180NJ	1150NJ
Selenium	15.0U	15.0U	15.0U	15.0U	15.0U	15.0U	15.0U	15.0U
Silver	2.4U	2.4U	2.4U	2.4U	2.4U	10.0N	10.0U	10.0U
Sodium	63600	24500	20900	25500	25900	27600	51200	29500
Thallium	1.6U	1.6U	1.6U	1.6U	1.6U	1.6U	1.6U	1.6U
Vanadium	35.7U	35.7U	35.7U	35.7U	35.7U	35.7U	35.7U	35.7U
Zinc	1110J	2080J	769J	776J	466J	321J	64.2J	745J

TABLE 4
 NUMERIC STANDARDS OF QUALITY
 SILVER CREEK
 STATE OF UTAH
 WASTEWATER DISPOSAL REGULATIONS

	DOMESTIC SOURCE (1C) (Max. ug/l)	AQUATIC WILDLIFE (3A) 4 Day Avg./1 Hr. Avg. (ug/l)	AGRICULTURAL (4) (Max. ug/l)	HUMAN HEALTH (B) (ug/l)
Antimony				146
Arsenic	50	190/360 (tri As)	100	.002
Barium	1000			
Beryllium				.0037
Cadmium	10	2.5/12.5 ^A	10	10
Chromium	50	11/16 (hex Cr) 480/4035 (tri Cr) ^A	100	50
Copper		28.5/47 ^A	200	1000
Iron		1000 (Max.)		
Lead	50	2.5/5.7 ^A	100	50
Mercury	2	.012/2.4		.144
Nickel		377/3390 ^A		13.4
Selenium	10	5/20	50	10
Silver	50	/24 ^A		50
Zinc		254/280 ^A		5000

^A - Based on hardness level of 280 mg/l as CaCO₃.

^B - Human health criteria applied to all Class 1C water bodies to protect for the consumption of water and aquatic organisms.

TABLE 5
FEDERAL QUALITY CRITERIA FOR WATER
RICHARDSON FLATS TAILINGS
TDD #T08-9204-015
(Concentration in ug/l Unless Otherwise Stated)

	CRITERIA FOR PROTECTION OF FRESH WATER WILDLIFE		CRITERIA FOR PROTECTION OF HUMAN HEALTH	
	ACUTE CRITERIA	CHRONIC CRITERIA	WATER AND FISH INGESTION	FISH CONSUMPTION ONLY
Antimony	9000*	1600*	1.46	
Arsenic	850 (pent)* 360 (tri)	48 (pent)* 190 (tri)	2.2 ng/l**	17.5 ng/l**
Barium			1 mg/l	
Beryllium	130*	5.3*	6.8 ng/l**	117 ng/l**
Cadmium	12.5A	2.5A	10	
Chromium (hex)	16	11	50	
Chromium (tri)			170 mg/l	3433 mg/l
Copper	46.8A	28.5A		
Iron		1000	0.3 mg/l	
Lead	303A	11.8A	50	
Manganese			50	100
Mercury	2.4	0.012	144 ng/l	146 ng/l
Nickel	3390A	377A	13.4	100
Selenium	260	35	10	
Silver	24A	.12	50	
Thallium	1400*	40*	13	48
Zinc	280A	254A		

From: Quality Criteria for Water, 1986, EPA 440/5-86-001.

A - Calculated based on hardness at 280 mg/l CaCO₃.

* - Insufficient data to develop criteria. Value presented is the Lowest Observed Effect Level (LOEL).

** - Human health criteria for carcinogens reported for three risk levels. Values presented is the 10⁻⁶ risk level.

TABLE 6
 RICHARDSON FLATS TAILINGS
 INORGANIC ANALYTICAL RESULTS FOR GROUNDWATER
 CONCENTRATION IN µg/l
 TDD #T08-9204-015

ANALYTE	RF-GW-04		RF-GW-05		RF-GW-09	
	TOTAL	DISSOLVED (FILTERED)	TOTAL	DISSOLVED (FILTERED)	TOTAL	DISSOLVED (FILTERED)
Aluminum	15700	191NJ	2690	49.6NJ	1630	68.5NJ
Antimony	24.3U	33.2NJ	24.3U	40.5NJ	28.4NJ	35.9NJ
Arsenic	3.7NJ	3.6U	5.2NJ	3.6U	11.3J	8.8NJ
Barium	196NJ	93.9NJ	99.6NJ	64.NJ	58.3NJ	46.2NJ
Beryllium	1.3NJ	0.90U	3.4NJ	1.8NJ	4.9NJ	3.7NJ
Cadmium	3.3U	3.3U	3.3U	3.3U	3.3U	3.3U
Calcium	42200	43500	191000	196000	318000	365000
Chromium	10.5	7.8U	7.8U	7.8U	7.8U	7.8U
Cobalt	11.0NJ	6.0U	7.5NJ	6.0U	9.0NJ	6.0U
Copper	30.0	171J	30.0	20.0NJ	20.0NJ	20.0U
Iron	14100	151	3180	62.6NJ	3190NJ	2170
Lead	627J	40.9J	15.6J	2.2U	31.0J	2.2U
Magnesium	12200	8380	44200	41800	52500	55000
Manganese	162J	19.5J	890J	684J	6670J	7420J
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U
Nickel	13.0NJ	11.1U	11.1U	24.9B	25.6NJ	28.9NJ
Potassium	3970NJ	1360NJ	6060	5530	3290NJ	3010NJ
Selenium	3.0U	3.0U	15.0U	15.0U	15.0U	15.0U
Silver	2.4U	10.0U	2.4U	10.0U	3.3NJ	10.0U
Sodium	16100	16800	38100	35700	48600	49700
Thallium	1.6U	1.6U	1.6U	1.6UW	1.6U	1.6U
Vanadium	35.7U	35.7U	35.7U	35.7U	35.7U	35.7U
Zinc	136J	20.1J	99.5J	14.4NJ	92.5J	13.1NJ

TABLE 7
 RICHARDSON FLATS TAILINGS
 INORGANIC ANALYTICAL RESULTS FOR SEDIMENT
 CONCENTRATION IN mg/kg
 TDD #T08-9204-015

ANALYTE	NORMAL RANGE (mg/kg) *	RF-SE-01	RF-SE-01D	RF-SE-02	RF-SE-03	RF-SE-04
Aluminum	29000-116000	28800	28300	1930	4530	11800
Antimony	0.22-1.01	98.5J	97.2J	85.4J	99.0J	40.1J
Arsenic	2.8-10.9	202J	128J	189J	310J	189J
Barium	337-998	260	307	92.1	157	562
Beryllium	0.30-1.56	2.3	2.2	1.2NJ	1.1NJ	2.3NJ
Cadmium	0.01-2.0***	75.6J	93.1J	52.8J	64.9J	40.3J
Calcium		39800	50800	56300	51000	96000
Chromium	19-90	57.7J	62.4J	15.8J	14.9J	25.0J
Cobalt	3.6-14.0	13.4	20.0	5.8NJ	19.3	10.4NJ
Copper	10-43	571	725	183	313	190
Iron	10600-41000	31400	42800	31100	91900	64400
Lead	9-31	6520	6210	3010	5220	2350
Magnesium		14100	14100	13800	11900	10900
Manganese	192-752	3100	5060	2200	2330	42000
Mercury	0.02-0.11	5.9J	8.2J	2.7J	2.4J	1.3J
Nickel	7-32	41.6	51.2	13.2	21.3	97.2
Potassium		4760	4760	886NJ	1120	2710
Selenium	0.09-0.56	9.9J	14.5J	11.4J	43.1J	12.0J
Silver	0.01-8***	28.2J	41.3J	10.7J	16.3J	8.0J
Sodium		472NJ	555NJ	206NJ	634NJ	1150
Thallium	0.1-0.8***	7.1	7.8	13.6	7.8	6.6
Vanadium	36-136	65.4	70.6	9.5NJ	17.8	28.4
Zinc	31-98	12700	15200	8160	11200	5400

* Data From: Shacklette, H.T., and Boerngen J.G., 1984; Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270, 105pp.

*** - Bowen, H.J.M., 1979, Environmental Chemistry of the Elements, Academic Press, N.Y.

TABLE 8
 RICHARDSON FLATS TAILINGS
 INORGANIC ANALYTICAL RESULTS FOR GROUNDWATER - LANDFILL AREA
 CONCENTRATION IN µg/L
 TDD #T08-9210-041

ANALYTE	RF-MW-01		RF-MW-02		RF-MW-03	
	TOTAL	DISSOLVED (FILTERED)	TOTAL	DISSOLVED (FILTERED)	TOTAL	DISSOLVED (FILTERED)
Aluminum	4600 J	18.1 UJ	94900 J	1710 J	58000 J	16.3 UJ
Antimony	14.8 U	14.8 U	14.8 U	14.8 U	14.8 U	14.8 U
Arsenic	3.8 J	3.2 U	66.8	24.2	81.1	58.5
Barium	178 J	123 J	1180	125 J	622	84.2 J
Beryllium	0.35 U	0.30 U	4.6 J	0.30 U	3.2 J	0.30 U
Cadmium	1.5 U	1.5 U	38.1	1.5 U	1.5 U	1.5 U
Calcium	102000	100000	320000	298000	230000	209000
Chromium	3.7 J	2.6 UJ	110 J	2.6 UJ	66.7 J	2.6 UJ
Cobalt	1.8 U	1.3 U	44.9 J	15.4 U	36.1 J	3.5 U
Copper	7.4 U	1.9 U	142	1.9 U	51.8 U	1.9 U
Iron	3410	5.8 U	77700	859	58000	5210
Lead	1.6 J	2.9 J	187	1.7 J	29.5	3.9
Magnesium	21900	21000	74800	47800	75800	54300
Manganese	150	74.9	22300	19900	11500	8350
Mercury	0.33	0.17	0.49	0.10 U	0.10 U	0.17
Nickel	2.7 U	2.6 U	93.1	16.4 U	71.2	8.6 U
Potassium	1780 J	1460 J	22100 J	3800 J	12800 J	1070 J
Selenium	3.9 U	3.9 U	19.5 UJ	3.9 U	19.5 UJ	3.9 U
Silver	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Sodium	26200	26000	83600	82400	85900	84000
Thallium	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U
Vanadium	6.8 J	3.2 J	149	3.4 J	88.9	2.5 U
Zinc	24.7 U	7.0 U	448	20.6 U	177	5.7 U

TABLE 8 CONT.
 RICHARDSON FLATS TAILINGS
 INORGANIC ANALYTICAL RESULTS FOR GROUNDWATER - LANDFILL AREA
 CONCENTRATION IN µg/L
 TDD #T08-9210-041

ANALYTE	RF-MW-03 (DUP.)		RF-GW-04		RF-GW-30
	TOTAL	DISSOLVED (FILTERED)	TOTAL	DISSOLVED (FILTERED)	(RINSATE BLANK)
Aluminum	44700 J	14.7 UJ	15700	191 B	14.7 UJ
Antimony	14.8 U	14.8 U	24.3 U	33.2 B	17.9 J
Arsenic	81.7	70.0	3.7 B	3.6 U	3.2 U
Barium	514	85.1 J	196 B	93.9 B	1.4 U
Beryllium	2.4 U	0.30 U	1.3 B	0.90 U	0.30 U
Cadmium	1.5 U	1.5 U	3.3 U	3.3 U	1.5 U
Calcium	230000	211000	42200	43500	201 J
Chromium	48.8 J	2.6 UJ	10.5	7.8 U	2.6 UJ
Cobalt	28.2 J	3.5 U	11.0 B	6.0 U	1.3 U
Copper	37.6 U	1.9 U	30.0	171 EN*	1.9 U
Iron	44900	5240	14100	151	18.1 U
Lead	29.9	2.7 J	627 N*	40.9 N*	2.7 J
Magnesium	72000	54900	12200	8380	49.6 U
Manganese	11200	8440	162 E	19.5 E	7.0 U
Mercury	0.10 U	0.10 U	0.20 U	0.20 U	0.10 U
Nickel	55.1	7.2 U	13.0 B	11.1 U	3.4 U
Potassium	10500 J	1060 J	3970 B	1360 B	108 J
Selenium	19.5 UJ	3.9 U	3.0 UNW	3.0 UN	3.9 U
Silver	3.6 U	3.6 U	2.4 UN	10.0 UN	3.6 U
Sodium	87800	84700	16100	16800	259 J
Thallium	3.8 U	3.8 U	1.6 U	1.6 U	3.8 U
Vanadium	69.5	2.6 J	35.7 UN	35.7 UN	2.5 U
Zinc	136	5.7 U	136 EN	20.1 EN	5.7 U

TABLE 9
RICHARDSON FLATS TAILINGS
LIST OF INORGANIC DATA QUALIFIERS
TDD #T08-9204-015

B - Entered if the reported value is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).

E - The reported value is estimated because of the presence of interference. An explanatory note must be included under comments on the Cover Page (if the problem applies to all samples) or on the specific FORM I-IN (if it is an isolated problem).

J - The associated numerical value is an estimated quantity because the reported concentrations were less than the required detection limits or quality control criteria were not met.

N - Matrix spiked sample recovery not within control limits.

S - The reported value was determined by the Method of Standard Additions (MSA).

U - Entered if the analyte was analyzed for but not detected, i.e., less than the IDL.

W - Post digestion spike for Furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.

* - Duplicate analysis is not within control limits.

+ - Correlation coefficient for the MSA is less than 0.995.

APPENDIX A

MEMO TO EPA/OSC DATED AUGUST 6, 1992,
INSPECTION OF THE TAILINGS DAM AT RICHARDSON FLATS



ecology and environment. inc.

1776 SOUTH JACKSON STREET, DENVER, COLORADO 80210, TEL. 303-757-4964

International Specialists in the Environment

Memorandum

To: Mike Zimmerman
EPA-OSC
From: Mike Sullivan
TAT Region 8
Date: 8/6/92
Subject: Inspection of the Tailings Dam at Richardson Flats T08-9204-015.

Under TDD# T08-9204-015 the U. S. Environmental Protection Agency (EPA) tasked the Ecology & Environment, Inc. Technical Assistance Team (TAT) to inspect the Tailings Dam at the Richardson Flats Tailings Pond near Park City, Utah and to provide a report on the findings of the inspection. The inspection did not encompass any trenching or boring in the embankment which would be required for a full assessment of the structure. This report relies heavily on the two reports generated by Dames and Moore, Inc., and on a visual inspection of the structure. The Dames & Moore reports are "Report of Embankment and Design Requirements Proposed Tailings Pond Development Near Park City, Utah for Park City Ventures Corporation" (1974) and "Report on Tailing Pond Investigation near Park City, Utah for Noranda Mining, Inc" (1980).

BACKGROUND

The Richardson Flats Tailings Pond, located near Park City, Utah, was a tailings pond which received slurried mill and mine wastes from mining operations in the Park City area. Tailings were transported to the pond via a slurry pipeline. According to the historical records, Richardson Flats was originally a flat area with intermittent drainages and Silver Creek running across it. The area was somewhat marshy and boggy. The original tailings dam was constructed of organic soils excavated from the site and piled up to form a small berm. Later raises for the embankment were constructed, as needed, out of sands, gravels, organic silts, as well as rubbish and garbage (Dames & Moore, Inc 1974).

In 1974 Dames & Moore, Inc. was contracted by Park City Ventures Corporation, the owners of the mine, to investigate enlarging the tailings pond. Dames & Moore Inc., was to provide design requirements for the proposed embankments with special attention given to minimizing seepage of contaminated pond effluent from the tailings pond. The investigation program consisted of exploratory

boring, test pits, laboratory analysis for strength characteristics of the soils, and analysis of the data to provide design requirements. The report called for construction of a main embankment, a dike along the southern and northern ends of the pond, and construction of a diversion ditch to route runoff away from the pond.

In 1974 the embankments and diversion ditch were constructed, generally in accordance with the requirements as outlined in the Dames & Moore report.

In 1980 Dames & Moore, Inc. again investigated the structure for Noranda Mining, Inc., the new owners of the mine. As stated in the reports introduction the objective of this investigation was to "... assess the overall condition and usefulness of the existing facilities and to determine what measures will be required for long-term tailings disposal from the Park City mine." In this report Dames & Moore noted that enlargement of the embankment had not been "...built according to recommendations ..." and that the fill was not "...properly engineered during construction.". Specific problems noted by Dames & Moore in the construction of the main embankment included: oversteepened slopes of approximately 1.5:1.0 in many places, no evidence of internal zoning of the embankment (clay core), the recommended drainage zone at the downstream toe was not installed, and that overall compaction of the material in the embankment was poor. Also noted at this time was "... considerable seepage in the form of small seeps and marshy areas on the northwest abutment and at the downstream toe of the main embankment...". The report recommended adding a drainage blanket to the toe of the embankment, flattening the oversteepened slope of the main embankment, and gave construction sequences for adding to the dikes.

FIELD INSPECTION

On August 4, 1992 TATm Sullivan inspected the main abutment of the Tailings Pond. From visual inspection and referencing the cross sections provided in the Dames & Moore report it appears that the dike was raised from the 1980 levels although not to the ultimate design levels. It is probable that the main embankment was also raised at the same time. No data is available on the construction or construction inspection of this last round of construction. The visual inspection also indicated that the oversteepened slope of the main embankment had not been flattened and that the drainage zone at the toe of the main embankment had not been installed.

The Main Embankment-

The main embankment is about 30 feet high with a slope length of approximately 50 feet. The main embankment is oversteep lying at 1.0:1.0 to 1.5:1.0 (run:rise). Approximately 6" of fine dry sand, possibly windblown tailings, was noted under a 3" topsoil cover layer on the downstream face of the embankment. The sand has no

strength and will erode quickly if exposed. A 35% to 50% grass cover was on most of the embankment which will help in erosion control. No cracking was evident on the embankment, although the sand layer would tend to hide any small cracking. Also, no bending (bulging) was noted on the embankment.

Toe of the Main Embankment-

Rank vegetation, in the form of willows and trees, is growing at the toe of the dam. Approximately 8" of loamy damp soils are evident on the toe of the dam. The amount of vegetation and the type of soils on the toe of the dam indicate that the area receives a lot of water. As the wet soils were noted approximately 6 to 8 feet above the stream level this water is probably due to seepage under the dam. Other evidence of seepage from the toe of the dam was evident in the form of; soft marshy areas, rank vegetation including willows, loamy soils, damp soils, and areas where water had been standing (although no standing water was observed on August 4th).

The North Abutment-

A swampy, loamy area on the north abutment, adjacent to where the embankment meets the abutment, was noted. The area was well above the toe of the dam at the location of the north monitoring well. The north abutment well recharged well when bailed. These conditions indicate that water seeps around or through the contact between the abutment and the embankment. Under full head conditions (saturated tailings) this could be an area where failure of the embankment could occur.

Crest of the Main Embankment-

The crest is sloped back toward the tailings pond allowing any water to drain back to the tailings pond. However, small erosional gullies are forming on the crest and downstream face of the dam and could eventually lead to larger gullying on the dam.

Water Flow-

Water elevations behind the embankment are unknown, however the elevation of water in the ditch and the pond south of the tailings pond are probably indicative of the elevation of groundwater behind the embankment. From the information available in the Dames & Moore, Inc. reports, it is unlikely that a cutoff wall was installed around the perimeter of the pond to control seepage under either the embankment or the dike. The piezometer located on the toe of the dam indicated the water level to be 5 feet below ground. The swampy ground and recharge rate of the monitoring well on the north abutment indicates that water flow from some source is occurring. Inspection of the road cut north of the abutment revealed no seeps. Without further investigation it is conservative to use a worst case scenario and assume that the source of the seep is the water in the tailings behind the dam and

that the abutment\embankment contact is a drainage path for the water.

Perimeter Dike-

The perimeter dike was probably constructed by stripping materials off of the downstream side and piling the undifferentiated material up as a dike. The slopes are approximately 2.0:1.0. The dike is used as the access road for the pond and its elevation varies from 2 to 5 feet above the level of the tailings in the pond. The dike appears to be in good condition.

Diversion Ditch-

The diversion ditch has been constructed along the perimeter of the tailings pond as designed by Dames & Moore. The ditch depth and width varies, generally getting deeper and wider as it progresses downstream. Standing water was evident in most of the ditch on the southern perimeter of the property. Rushes, sedges, and cattails were growing in the bottom of the ditch along the entire length. Recent work has been performed by the owners in flattening the ditch banks and adding topsoil to the banks. This work is approximately one-half completed. According to the owners, the rest of the ditch is to be similarly regraded and topsoiled. At the time TAT inspected the site, the hillside diversion ditch, on the north perimeter of the tailings pond, had been cut off from the main ditch as a result of topsoil stripping. This important feature should be reconnected to the main ditch as soon as feasible to prevent additional water flowing into the tailings pond.

CONCLUSIONS

Based on TATs inspection, the previous investigation conducted by Dames & Moore, and that the tailings pond seems to be essentially dry, there would appear to be no imminent threat of failure of the main embankment. Failure could occur due to the oversteepened nature of the embankment, especially if the embankment becomes saturated due either to saturation of the tailings or to saturation of the embankment itself. A threat exists of undermining of the dam through the uncontrolled seepage areas located along the toe of the main embankment and on the north abutment. Again the threat would be increased if the tailings become saturated thus increasing the head pressure and possibly the velocity of water flow through the seeps.

The property owners are keeping open the option of reactivating the tailings pond. If the tailings pond is reactivated additional recommended actions are noted in paragraph B. below.

RECOMMENDATIONS

- A. Keeping the tailings pond dry through the maintenance of the diversion ditches will do the most to prevent failure of the embankment and a possible release of the tailings into the environment. The connection between the hillside diversion

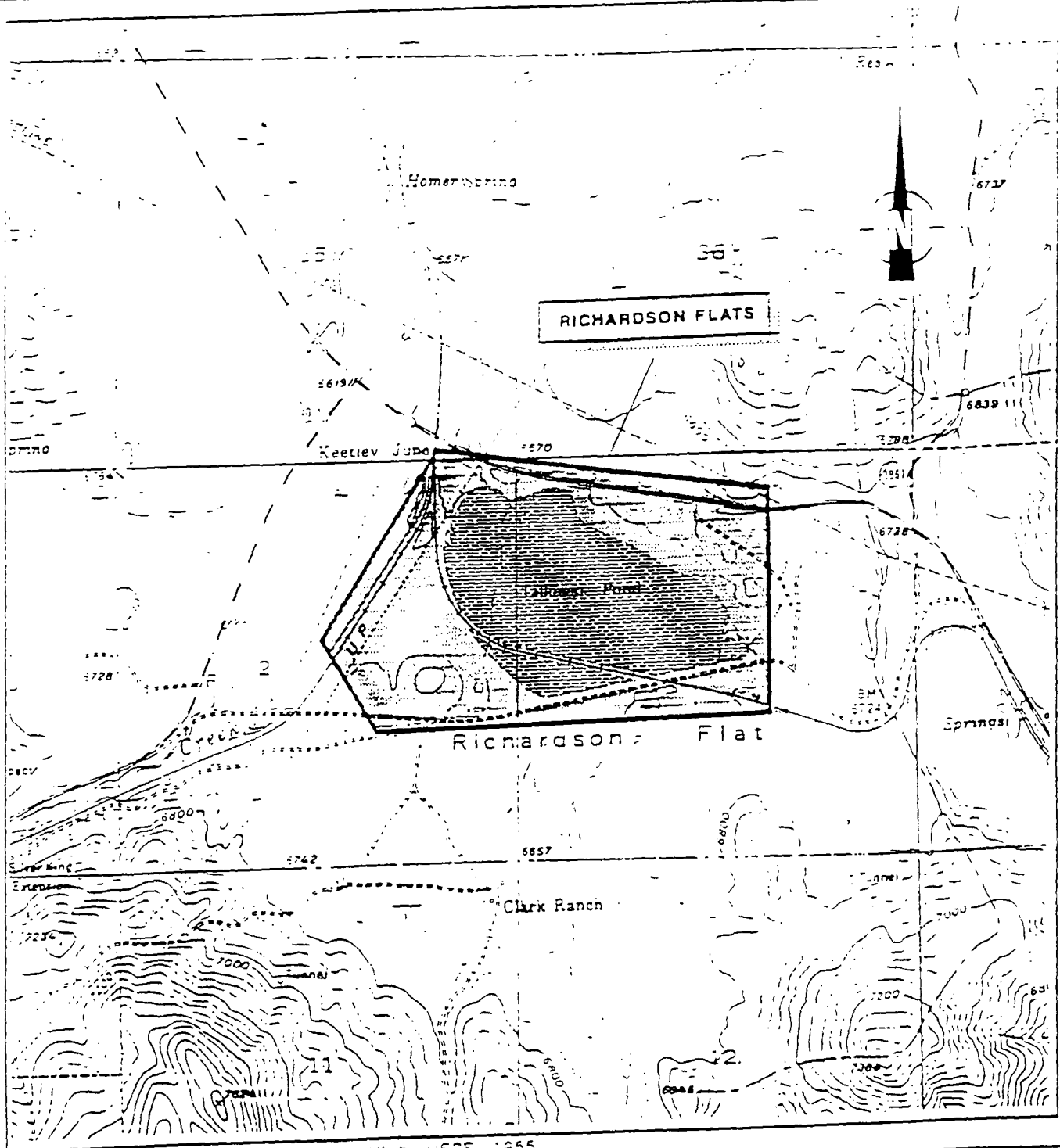
ditch and the perimeter diversion ditch should be restored. In the future, the slopes on the main embankment should be flattened to 2.0:1.0 or greater, and the toe drainage blanket should be installed to allow liquids to drain away from the embankment. A monitoring well should be installed on the top of the tailings pond next to the embankment to monitor the elevation of groundwater within the pond and at the embankment. With water level elevation data available for both upstream of the embankment and at the toe of the embankment better, evaluations of the stability of the structure can be made. If any seeps appear on the embankment they should be monitored for both quantity and quality. Seeps carrying a sediment load generally indicate that active undermining of the embankment may be occurring. Undesirable vegetation in the form of willows and trees should be removed from the embankment.

- B. If the pond is to be used for tailings deposition, saturation of the existing tailings is a distinct possibility. With saturation, the possibility of failure of the embankment is raised due to the oversteepened slopes, the existing seeps in the downstream toe of the dam, and the seeps along the north abutment. Saturation of the tailings would increase the head pressure on the seeps, possibly increasing the velocity and amount of water seeping through the embankment. Also, saturation of the tailings will tend to raise the water surface within the embankment itself. Wetting of the material within the embankment can significantly reduce the ability of the material to resist failure. Because the embankment is apparently constructed of undifferentiated materials it would be prudent to add in the drainage blanket at the toe of the embankment and to flatten the embankment as recommended in the 1980 Dames & Moore report. The possibility of a cut-off wall being installed in the embankment should also be investigated. Also, continual monitoring of the seepage from the toe, installation of a network of piezometers and inclinometers is recommended to continually assess the integrity and stability of the embankment.

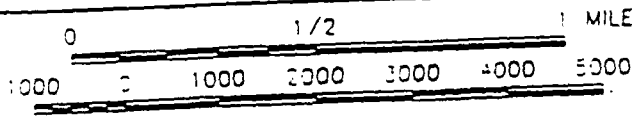
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Source: Park City East Quadrangle, Utah, USGS, 1955



LOCATION MAP



LEGEND

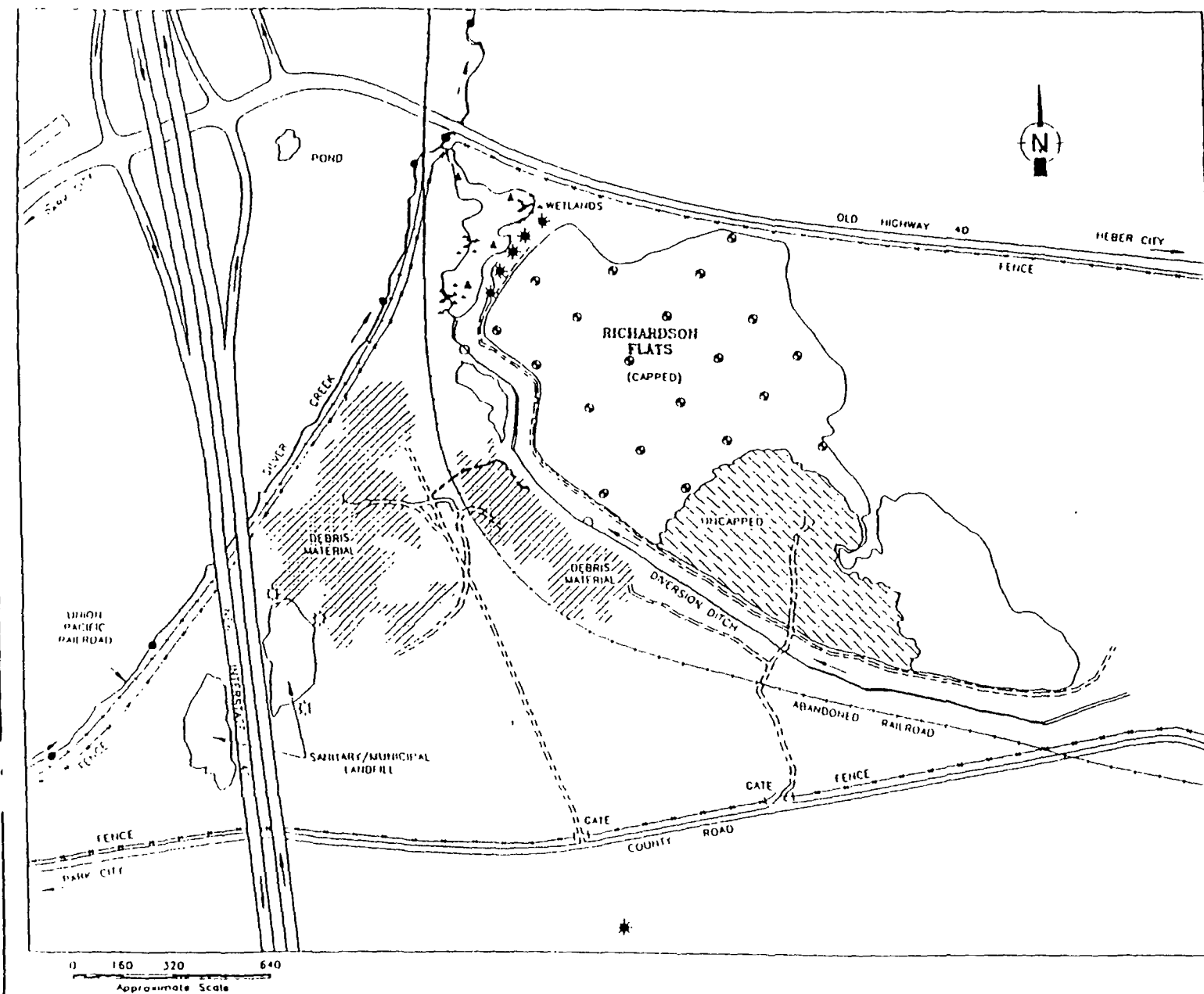
Site location

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY
RESPONSE, REMOVAL AND PREVENTION
EPA CONTRACT 66-WO-0037

TITLE:
RICHARDSON FLATS
Park City, Utah
SITE LOCATION MAP
T.D.D. T08-9204-015

ecology & environment, inc.
DENVER, COLORADO

FIG. 1



LEGEND

- ★ Approximate location of existing monitoring wells to be sampled
- ☼ Proposed monitoring wells to be installed and sampled
- Location of surface water samples from Silver Creek
- Surface water samples from diversion ditch (Two upgradient locations will be determined at the time of sampling in the Northeast portion of the site)
- ▲ Location of sediment samples
- ⊙ Location of soil boring

Note: All air samples will be collected off site

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION EPA CONTRACT 68-WO-0037	
TITLE: RICHARDSON FLATS Salt Lake City, Utah SALT LAKE LOCATION MAP	
T.O.D. 108-9204-115	
ecology & environment, inc. DENVER, COLORADO	FIG. 2
Date: 09/82 Drawn by: RSM Scale:	

APPENDIX C: Influence of Tailings Impoundment on Silver Creek Water Quality

APPENDIX C

INFLUENCE OF TAILINGS IMPOUNDMENT ON SILVER CREEK WATER QUALITY

Using water monitoring data from the Site, simple mixing calculations were used to estimate the influence of seepage from the Richardson Flat tailings on the water quality in Silver Creek. The following equation was used:

$$C_{\text{mix}} = (C_1 V_1 + C_2 V_2) / (V_1 + V_2)$$

where: C_{mix} = the concentration resulting from mixing two waters (mg/l)

C_1 = the concentration of the first water (mg/l)

V_1 = the flow volume of the first water (cfs)

C_2 = the concentration of the second water (mg/l)

V_2 = the flow volume of the second water (cfs).

As shown in Tables C-1 and C-2, zinc concentrations were calculated for a variety of mixing scenarios. First, water from the south diversion ditch was added to Silver Creek using four scenarios:

- Assuming that Silver Creek meets the AWQ standard (0.37 mg/l)
- Using actual zinc concentrations for samples from Silver Creek upstream of the Site collected May 19, 1999 (Table C-1)
- Assuming Silver Creek zinc concentrations were 0.00 mg/l
- Assuming most of loading from Richardson Flat is eliminated

Second, seepage from the tailings embankment was added to Silver Creek at various seepage zinc concentrations and seepage flow rates (Table C-2).

Mixing water from the south diversion ditch with Silver Creek (Table C-1) resulted in water with slightly lower zinc concentrations because the zinc concentration (i.e., 0.15 mg/l) in diversion ditch water was lower than the AWQ standard (i.e., 0.37 mg/l) or the measured upstream concentration (i.e., 0.51 mg/l) in Silver Creek. The result from

sampling downstream (i.e., 0.49 mg/l) in Silver Creek on May 19, 1999 (see Table 4.4.3) is almost identical to the calculated value of 0.48 mg/l, suggesting that water from the tailings Site is actually slightly diluting the zinc concentrations in the creek. When Silver Creek zinc concentrations were assumed to be 0.00 mg/l, diversion ditch zinc concentrations of 4.1 mg/l were necessary to reach the AWQ limit. Measured zinc concentrations have never been this high in the ditch. At EPA's suggestion, an additional scenario was examined. Water from the south diversion ditch was assumed to be at background or upgradient concentrations. Water quality from two upgradient sample locations, RF-1 and RF-3, was used to represent water chemistry entering Silver Creek without any impact from the tailings impoundment. Zinc concentrations measured at these two locations in 1999 (Table 3.4) were averaged (resulting in 0.036 mg/l) and then mixed with zinc concentrations measured at RF-7 (0.51 mg/l). This resulted in a "mixed" zinc concentration of 0.47 mg/l for Silver Creek below the confluence of the diversion ditch outlet. Comparison of the "mixed" value with the Aquatic Wildlife criteria in Table 3.4 for RF-8 reveals that the "mixed" value would exceed both the acute and chronic criteria.

Mixing seepage from the tailings embankment with Silver Creek (Table C-2) using a variety of zinc concentrations and seepage rates results in no significant change in the zinc concentration in the creek. As shown in Table C-2, the zinc concentrations of the seepage were varied from 1.9 mg/l, the highest concentrations measured between 1991 and 1998 in the five monitoring wells, and 0.165 mg/l, the average concentration calculated from 87 samples collected from five monitoring wells between 1991 and 1998 (see Table 4.4.2.). In addition to the above and at EPA's suggestion, the seepage zinc concentrations was reduced to 0.036 mg/l, to simulate no impact from the tailing impoundment, and mixed with Silver Creek. The resulting "mixed" water chemistry is presented in Table C-2. As indicated, there is no change to water quality in Silver Creek with seep concentrations reduced to background concentrations. In other words, if the impoundment was not present, there would be no significant change to Silver Creek water quality. The seepage rates were varied from 0.048 gpm (the highest rate, 63 gpd, calculated by Weston, 1999) to

5 gpm (100 times the highest seepage rate calculated by Weston). Given the very small embankment seepage rates compared with the much larger flow of Silver Creek, the influence of embankment seepage on zinc concentrations is negligible. When assuming that Silver Creek zinc was 0.00 mg/l, in order to meet the AWQ limit, flow rates had to be 0.048 gpm to 5 gpm with zinc concentrations ranging from 12,400 mg/l to 108 mg/l, respectively. Zinc concentrations in the embankment wells never have been measured at either of these extremely high values.

The mixing analysis could be extended further by adding water from both the south diversion ditch and embankment seepage to Silver Creek. Although the mixing equation presented above could be extended to include three water sources, it is readily apparent that the resulting water would have a lower concentration than upstream Silver Creek. This would essentially have the same result that was calculated by mixing the diversion ditch water with Silver Creek.

Tables C-1 and C-2: Zinc Concentrations

Table C-1: Silver Creek and South Diversion Ditch

Mixing Equation Parameter:	Concentration 1 (mg/l)	Flow Volume 1 (cfs)	Concentration 2 (mg/l)	Flow Volume 2 (cfs)	Mixed Concentration (mg/l)
Water Source:	Silver Creek	Silver Creek	So. Diversion Ditch	So. Diversion Ditch	Silver Creek + So. Diversion Ditch
Notes					
Assuming Silver Creek Meets Standard	0.37	3.17	0.15	0.32	0.35
Actual Upstream Silver Creek Conc. (5/19/99)	0.51	3.17	0.15	0.32	0.48
Assuming Silver Creek Meets Standard, Increase So. Diversion Ditch Conc. to Increase Silver Creek Conc. by 25%	0.37	3.17	1.4	0.32	0.46
Actual Upstream Silver Creek Conc. (5/19/99), Increase So. Diversion Ditch Conc. to Increase Silver Creek Conc. by 25%	0.51	3.17	1.9	0.32	0.64
Assuming Silver Creek Contains 0 mg/l Zn, Calculate Zn Conc. Needed in So. Diversion Ditch to Exceed Standard	0	3.17	4.1	0.32	0.38
Actual upstream Silver Creek Conc. (5/19/99), assume So. Diversion Ditch concentrations equal to avg of upstream samples collected at RF-1 and RF-3 on 5/19/99. These samples represent non-impacted waters.	0.51	3.17	0.036	0.32	0.47

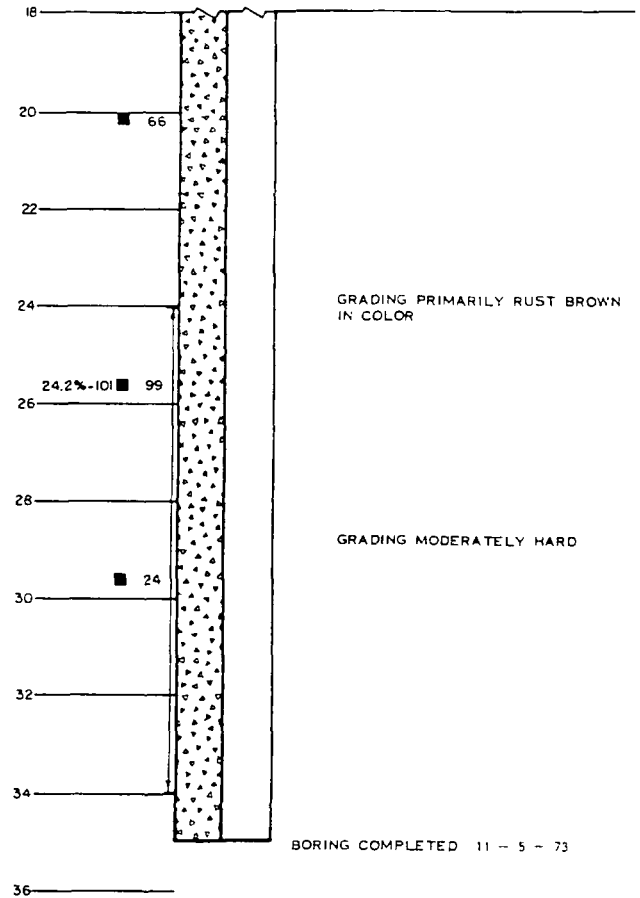
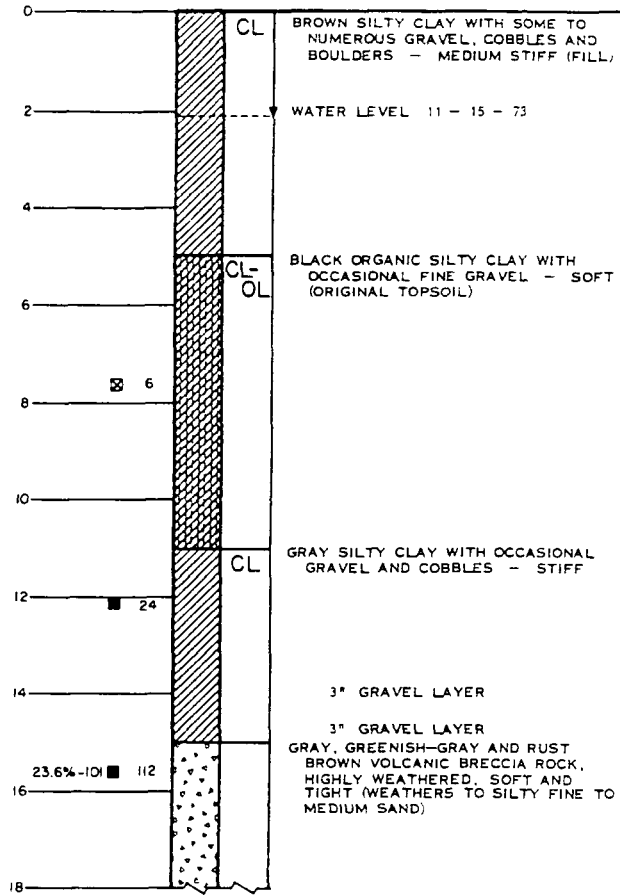
Table C-2: Silver Creek and Embankment Seepage

Mixing Equation Parameter:	Concentration 1 (mg/l)	Flow Volume 1 (cfs)	Concentration 2 (mg/l)	Flow Volume 2 (gpm)	Flow Volume 2 (cfs)	Mixed Concentration (mg/l)
Water Source:	Silver Creek (May 19, 1999)	Silver Creek (May 19, 1999)	Embankment Seepage	Embankment Seepage	Embankment Seepage	Silver Creek + Embankment Seepage
Notes						
Highest Seepage Conc., Highest Seepage Flow (Weston)	0.51	3.17	1.9	0.04375	0.00010	0.510
Highest Seepage Flow (Weston)	0.51	3.17	1.0	0.04375	0.00010	0.510
Average Seepage Conc., Highest Seepage Flow (Weston)	0.51	3.17	0.165	0.04375	0.00010	0.510
Highest Seepage Conc., Seepage Rate 10X Calculated (Weston)	0.51	3.17	1.9	0.5	0.00111	0.510
Seepage Rate 10X Calculated (Weston)	0.51	3.17	1.0	0.5	0.00111	0.510
Average Seepage Conc., Seepage Rate 10X Calculated (Weston)	0.51	3.17	0.165	0.5	0.00111	0.510
Highest Seepage Conc., Seepage Rate 20X Calculated (Weston)	0.51	3.17	1.9	1	0.00223	0.511
Seepage Rate 20X Calculated (Weston)	0.51	3.17	1.0	1	0.00223	0.510
Average Seepage Conc., Seepage Rate 20X Calculated (Weston)	0.51	3.17	0.165	1	0.00223	0.510
Highest Seepage Conc., Extreme High Seepage Rate	0.51	3.17	1.9	5	0.01114	0.515
Extreme High Seepage Rate	0.51	3.17	1.0	5	0.01114	0.512
Average Seepage Conc., Extreme High Seepage Rate	0.51	3.17	0.165	5	0.01114	0.509
Assuming Silver Creek Contains 0 mg/l Zn, Calculate Zn Conc. Needed in Embankment Seepage to Exceed Standard	0	3.17	12400	0.04375	0.00010	0.38
Assuming Silver Creek Contains 0 mg/l Zn, Calculate Zn Conc. Needed in Embankment Seepage to Exceed Standard	0	3.17	1080	0.5	0.00111	0.38
Assuming Silver Creek Contains 0 mg/l Zn, Calculate Zn Conc. Needed in Embankment Seepage to Exceed Standard	0	3.17	540	1	0.00223	0.38
Assuming Silver Creek Contains 0 mg/l Zn, Calculate Zn Conc. Needed in Embankment Seepage to Exceed Standard	0	3.17	108	5	0.01114	0.38

APPENDIX D: Boring and Completion Logs for Embankment Monitor Wells

MONITOR WELL 1

ELEVATION 6596.9 FEET



KEY

- A - B ■ C
- A FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL
- B DRY DENSITY EXPRESSED IN LBS. PER CUBIC FOOT
- C BLOWS PER FOOT OF PENETRATION USING A 140 LB HAMMER DROPPING 30 INCHES
- DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED
- ⊠ DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED
- ↓ SCREENED AND GRAVEL PACKED

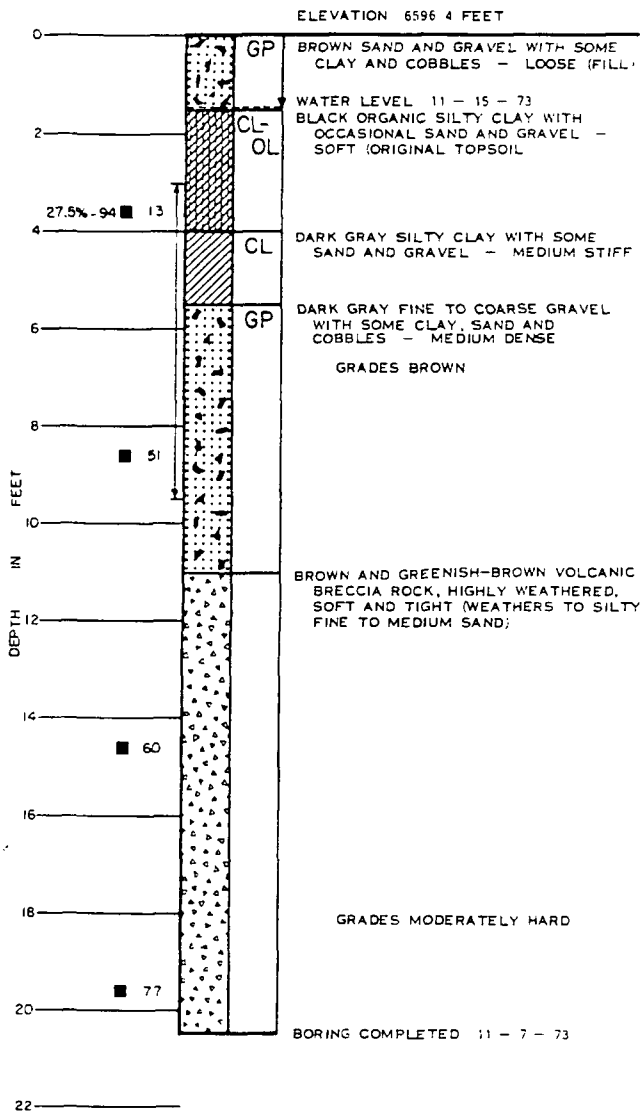
NOTES

THE DISCUSSION IN THE TEXT UNDER THE SECTION TITLED, "SITE CONDITIONS, SUBSURFACE", IS NECESSARY TO A PROPER UNDERSTANDING OF THE NATURE OF THE SUBSURFACE MATERIALS.

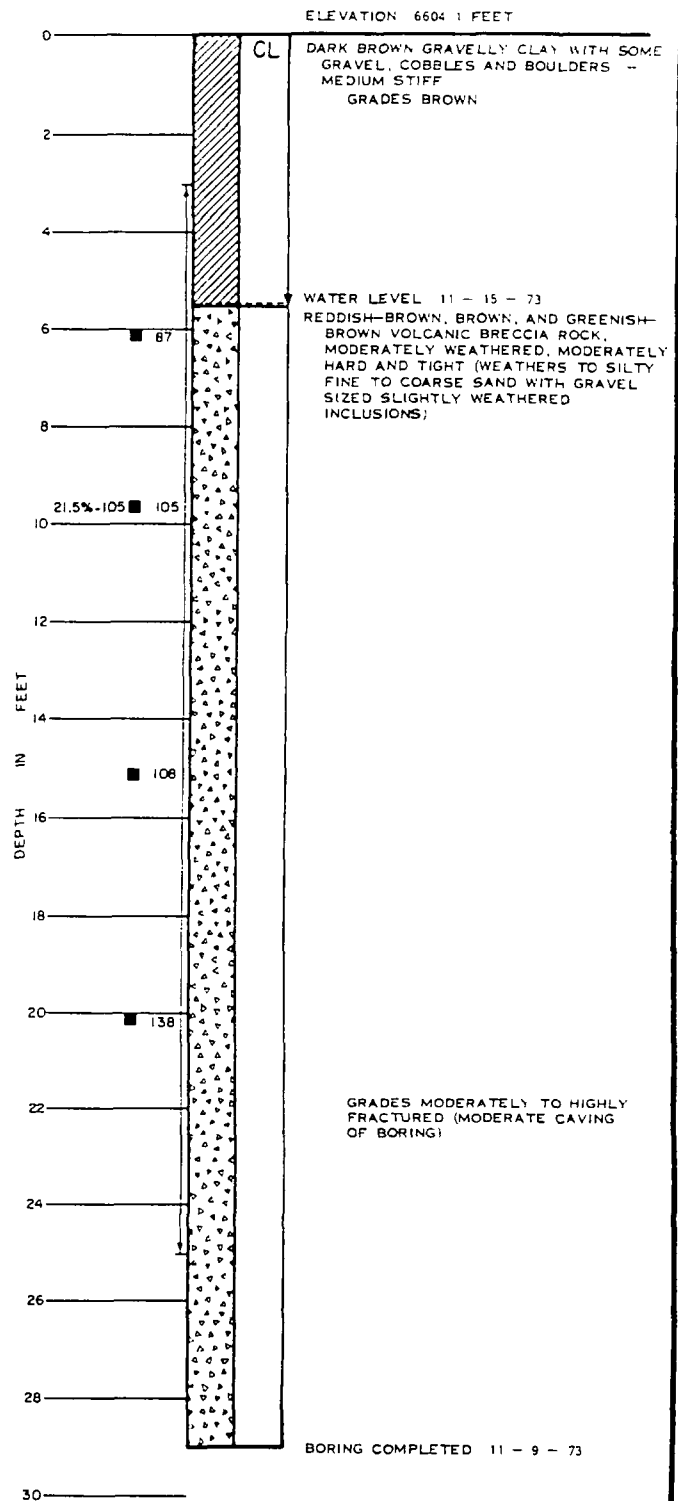
ZONE OF WELL WHICH IS GRAVEL PACKED AND SLOTTED IS INDICATED BY ARROW (↓) TO LEFT OF LOG OF MONITOR WELLS. OTHER ZONES OF WELL SEALED OFF FROM SLOTTED ZONE. SEE TEXT FOR DETAILS.

LOG OF MONITOR WELL

MONITOR WELL 2



MONITOR WELL 3



LOG OF MONITOR WELLS